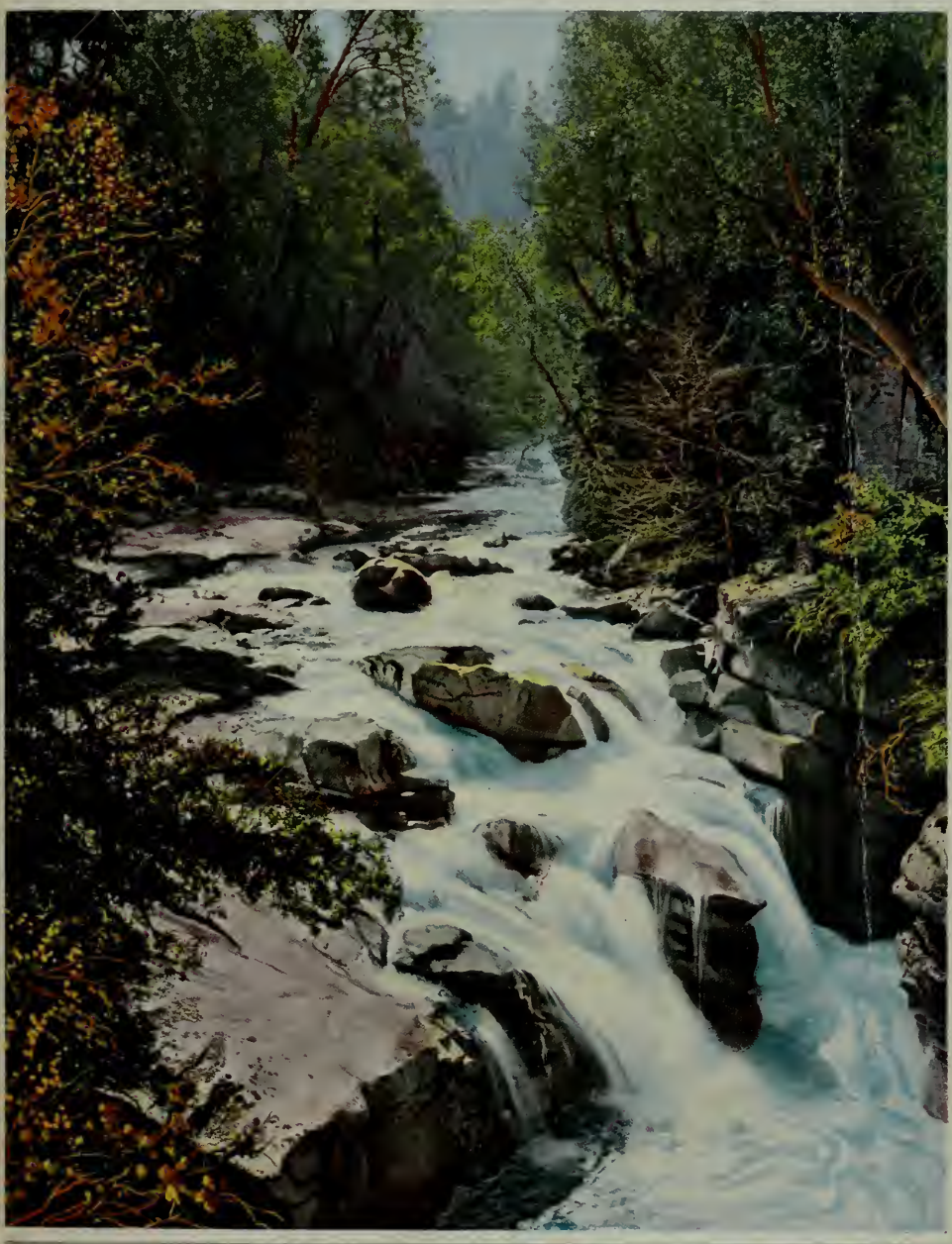
MEDICAL DEPARTMENT
SAN FRANCISCO HISTORY ROOM
SAN FRANCISCO PUBLIC LIBRARY
3 1223 04847 8961
SAN FRANCISCO PUBLIC LIBRARY
VITA SINE LITERIS MORS EST
BOOK NO. 621.3 P11 16
ACCESSION 450104
NOT TO BE TAKEN FROM THE LIBRARY
Form 37 10M 11-35

PACIFIC SERVICE MAGAZINE

BLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO SAN FRANCISCO



OREGON CREEK, TRIBUTARY OF THE MIDDLE YUBA, NEVADA COUNTY

Vol 16 — JULY 1924 — No 1

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER	A. B. C. DOHRMANN	FRANK A. LEACH, JR.
F. B. ANDERSON	JOHN S. DRUM	NORMAN B. LIVERMORE
CHAS. L. BARRETT	F. T. ELSEY	JOHN D. McKEE
W. E. CREED	D. H. FOOTE	JOHN A. McCANDLESS
W. H. CROCKER	A. F. HOCKENBEAMER	C. O. G MILLER

OFFICERS

W. E. CREED	*President*
FRANK A. LEACH, JR.	*First Vice-President and General Manager*
A. F. HOCKENBEAMER	*Second Vice-President and Treasurer*
D. H. FOOTE	*Third Vice-President and Secretary*
CHAS. L. BARRETT	*Assistant Secretary*
LEROY MOORE	*Assistant Treasurer*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, JR., Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney	LAW DEPARTMENT
C. P. CUTTEN, Attorney	RATE DEPARTMENT
R. J. CANTRELL, Manager	PROPERTY DEPARTMENT
E. W. HODGES, General Auditor	ACCOUNTING DEPARTMENT
H. T. TERRY	CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager	CREDIT AND STOCK SALES DEPARTMENTS
JOHN H. HUNT, Purchasing Agent	PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent	SUPPLY DEPARTMENT
E. G. McCANN, Manager	PERSONNEL DEPARTMENT
	ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT
O. W. PETERSON	Engineer of General Construction
E. H. STEELE	Engineer of Line Construction
F. R. GEORGE	Engineer of Operation
GEO. H. BRAGG	Engineer of Maintenance
	DEPARTMENT OF ENGINEERING
J. P. JOLLYMAN	Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER	Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE	Chief of Division of Civil Engineering
F. M. HARRIS	Chief of Bureau of Specifications and Estimates
O. A. KNOPP	Chief of Bureau of Tests and Inspection
	DEPARTMENT OF EXECUTIVE ENGINEER
F. C. PIATT	Valuation Engineer of Electric Properties
J. T. RYAN	Valuation Engineer of Gas, Water and Railway Properties
W. D. SULTAN	Rate Engineer
S. B. SHAW	Automotive Engineer
W. G. JACK	Manager Land Department
	GAS CONSTRUCTION AND OPERATION DEPARTMENT
FRANK WILLS	Engineer of Production
R. S. FULLER	Engineer of Distribution
HARRY J. SMITH	Engineer of Construction
	PUBLIC RELATIONS AND SALES DEPARTMENT
R. W. ROBINSON	Assistant to Vice-President in Charge of Public Relations and Sales
DON C. RAY	Manager Bureau of Public Relations
N. R. SUTHERLAND	Manager Commercial Department
H. M. CRAWFORD	Sales Manager
H. E. SANDOVAL	Manager Electric Sales
FORREST U. NAYLOR	Manager Gas Sales
J. CHARLES JORDAN	Manager Publicity Department

W. B. BOSLEY
General Counsel

JOHN P. COGHLAN
Assistant to the President

F. S MYRTLE
Editor-in-Chief Pacific Service Magazine

DIVISIONS AND MANAGERS

DIVISION MANAGERS		DISTRICT MANAGERS		HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION			Marysville
I. B. ADAMS	DE SABLA DIVISION			Chico
H. M. COOPER	DRUM DIVISION			Auburn
		L. H. HARTSOCK	Nevada District	Nevada City
L. H. NEWBERT	EAST BAY DIVISION			Oakland
		J. H. PAPE	Berkeley District	Berkeley
H. C. ROSS	FRESNO DIVISION			Fresno
H. G. RIDGWAY	NORTH BAY DIVISION			San Rafael
		L. J. PETERSON	Petaluma District	Petaluma
		C. D. CLARK	Napa District	Napa
		C. D. CLARK	Vallejo District	Vallejo
		M. G. HALL	Santa Rosa District	Santa Rosa
E. W. FLORENCE	SACRAMENTO DIVISION			Sacramento
		C. W. McKILLIP	Sacramento District	Sacramento
		C. E. SEDGWICK	Solano District	Dixon
		J. W. COONS	Yolo District	Woodland
HENRY BOSTWICK	SAN FRANCISCO DIVISION			San Francisco
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION			Modesto
		W. E. ESKEW	Electra District	Jackson
		C. R. GILL	Modesto District	Modesto
		J. H. FAGG	Stockton District	Stockton
		CHAS. H. NOACK	Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION			San Jose
		W. T. KELLOGG	Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION			Redding
H. B. HERYFORD	WEST SIDE DIVISION			Red Bluff
		STEPHEN GOIN	Willows District	Willows
		CHAS. HUGHES	Red Bluff District	Red Bluff

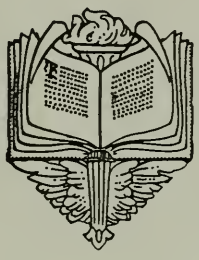
Pacific Service Magazine

Volume XVI Number 1

*621.3
P11 16

450104

Contents for July, 1924



Officials of the Department of Gas Construction and Operation, *Frontispiece*

GUARDING OUR COMPANY'S GAS SERVICE - - *Frank Wills* 3

YOUNG WOMEN OF "PACIFIC SERVICE" ASSIST IN CEREMONY - - - - - - - - - - - - - 7

GAS MEN OF THE P. C. G. A. STUDY PROBLEMS IN THE SOUTHLAND - - - - - - - - - - - - 8

IN THE CAUSE OF THE PUBLIC SERVICE—
The Pacific Coast Electrical Convention at Coronado - *F. S. Myrtle* 10

THE FINANCIAL SIDE OF "PACIFIC SERVICE" - - - *A. F. H.* 15

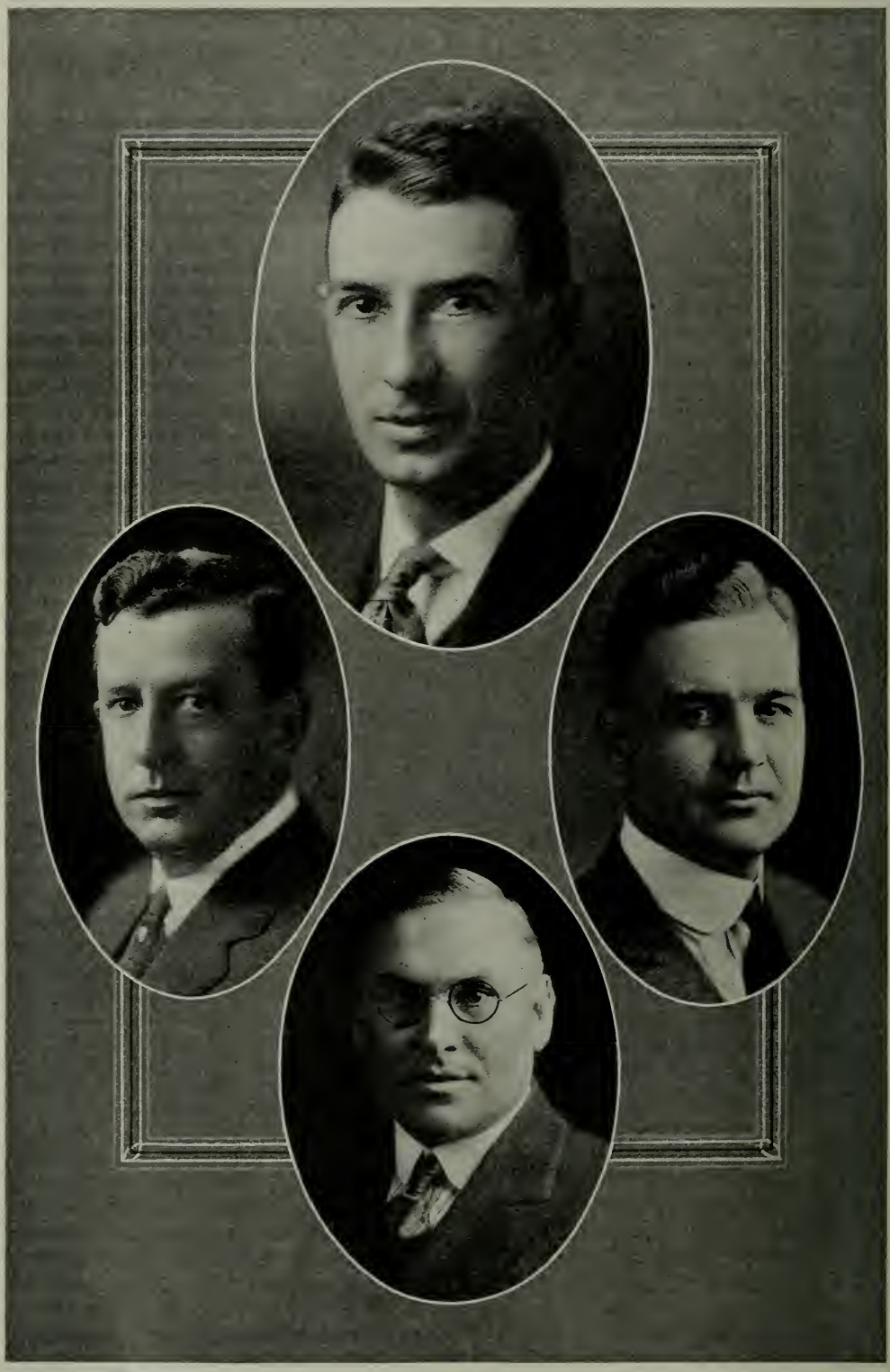
EDITORIAL - - - - - - - - - - - - - - - 18

FROM POWER HOUSE TO CONSUMER—
A Brief Discussion of Some of the Problems Encountered in Connection with the Transmission of Power as Generated in the Mountains, and Its Delivery to the Consumer - - - - - - - - *S. C. Pardee* 21

IN THE PATH OF STATE DEVELOPMENT - - - - - - 26

EIGHTH ANNUAL DINNER OF THE P. S. E. A. DRAWS RECORD ATTENDANCE - - - - - - - - - 30

A CALIFORNIA CORPORATION - - - - - - - - - - 32



Officials of the Department of Gas Construction and Operation. The upper portrait is of Mr. Willis S. Yard, vice-president in charge; at the left is Mr. Frank Wills, engineer of production; at the right Mr. R. S. Fuller, engineer of distribution; underneath, Mr. Harry J. Smith, engineer of construction.

PACIFIC SERVICE MAGAZINE

Volume XVI JULY, 1924 Number 1

Guarding Our Company's Gas Service

By FRANK WILLS, Engineer of Production, Department of Gas Operation and Construction

Quite often the activities of the larger departments of our company are given publicity, but it is possible that the work of a relatively small number of employees may be as interesting and, possibly, as important, although smaller in magnitude. Each district has a few individual employees who give all or a portion of their time to work which, if neglected, seriously endangers the success of our gas industry. This group comprises those who act as sentinels to detect deviations from the established standards of "Pacific Service."



Examining the control charts of a single day's setting

The building of plants, the installation of distribution systems and the completion of the organization to man them is but the establishment of the service. The standard of this service once started must be maintained. The passing of time, the growth of communities, the variation in materials available for gas making, the deterioration of the physical property and even the tendency of organization to "let down" all tend to change conditions, so that the mere establishment of good service does not of itself insure that it will automatically continue indefinitely to be equally good. The function of the sentinels referred to is to perpetuate the standards that have been established. They must keep constantly checking and testing each factor entering into the service as a whole, and then apply the knowledge and experience gained by this daily contact to forestall and prevent a depreciation of these standards.

Such a task requires patience, honesty of purpose and co-operation just as truly as any more exalted and more heralded duty. First, actual facts and reliable test results must be obtained; then, these must be analyzed and the findings of such examination made available to the operating department. The full details of how this work is actually accomplished in all districts is interesting but too complicated for so short a discussion as is here presented. The general procedure from one division is all that can be accomplished.

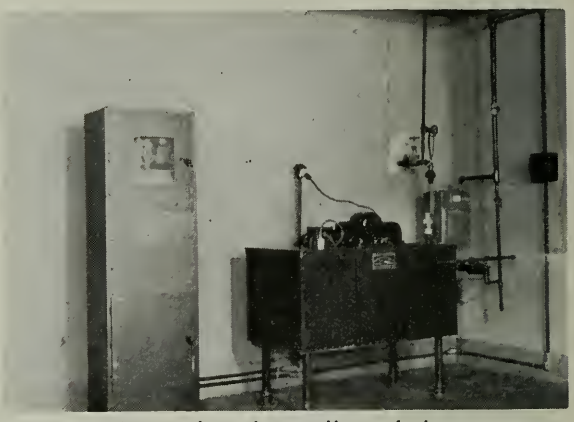


Changing control charts

Good gas service requires ample and uniform pressure, with proper and constant heating value and a

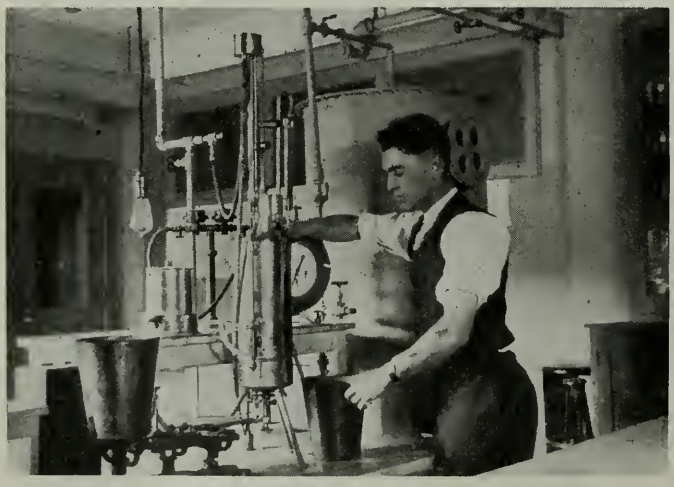
high degree of purity. This group of service workers is interested in these three fundamental factors. Those who inspect and study the pressure conditions are employed in the distribution department, while those who test and examine the gas for quality and impurities belong in the manufacturing department.

GAS PRESSURE. The pressure of the gas in the street mains is supplied by either the gas holders, boosting fans, or compressors at the gas plant. Good service for domestic purposes requires that the pressure be between two and twelve inches of water column (.072 to .43 per pound per square inch) at the outlet of the consumer's meter. This is a very light pressure. It is less than that which one can blow with his lungs, yet it has been found by the Railroad Commission to be the most satisfactory standard. Although good service may be had within this range of pressure, it is necessary that there be only slight and very gradual variations at any one location. It is possible to have slightly higher pressures near the plant than at more distant points so long as the variations at either place are not sharp or excessive. Where distribution systems are large, or where communities at a considerable distance from the plant are served, it is necessary to transmit the gas from the plant under high pressure (up to 100 pounds per square inch) to the desired point and then reduce the pressure to from two to twelve inches water column by regulators as it is discharged into the distribution mains or delivered to the consumer's meters. The maintenance of standard pressure conditions at so low a pressure and with such slight variation becomes somewhat complicated on the larger systems where combinations of high and low pressure mains are used.



Automatic and recording calorimeter

A great variety of causes may contribute to bring about conditions which result in pressures being too low or too high. The consumption of gas may increase to such an extent that the demand is beyond the delivery capacity of the boosting and compressing apparatus or beyond the carrying capacity of the mains. The number of consumers upon some sections of a distribution system increases very rapidly as the building progresses and the population becomes more dense. Consumers often replace small gas appliances with larger ones or add more equipment, causing a consumption in excess of the capacity of their service pipe or meter. There are also stoppages in the mains due to condensation from the gas and an occasional defective regulator. Against all these must the distribution man be on guard.



Using a Hinman-Junkers calorimeter and continuous sample device

For control purposes stations are established for

taking pressure tests. The locations are selected carefully. One is at the outlet of the plant with gauges on each main leaving it. Others are on feeder lines to each section of the distribution mains and on the inlet and outlet of the district regulators through which high pressure gas is fed to the low pressure mains. The tests are made with recording instruments which draw upon a circular chart a line indicating the pressure for twenty-four hours. Each day these charts are replaced. There is a chart for each day of the year and a certain colored ink is used for each year. Changes in pressure conditions in any section of the system are thus readily detected.



Laboratory at the Potrero Gas Works, San Francisco

In addition to these control tests portable recording gauges are used to test the pressures actually received by consumers at the outlet of their meter. It is impossible to make such a test for each consumer, but a certain number of gauges are set each day always at different locations according to a routing schedule made out by a dispatching clerk. These pressure surveys are very valuable, as they show whether or not the control stations have been well chosen and if there is a sufficient number of these stations. They also show the effects of the service pipes and meter upon loss in pressure, which is a check upon their capacity. Upon the back of these pressure survey charts is provided space for the employee to enter information as to the size of piping, regulator and meter used at the address where the test is taken. The consumer's appliances are also listed. This information is useful in analyzing the conditions which the gauge has recorded for the rate of consumption required by that particular consumer.

Through these control and survey pressure charts the distribution department is able to locate stoppages in mains, detect defects in regulators and forestall the need of readjustment of regulators, changes necessary in the initial pressure which the plant must supply for the various peak and off-peak hours, and the approaching necessity for additional mains. Skillful and careful handling of these tests prevents any letting down in good pressure standards.



Laboratory at Oakland Gas Works

Over the entire system during each day about one hundred and twenty-five control charts are put out and about twenty survey gauges set. If conducted entirely within one district this would require about ten men, eight hours per day, seven days per week. The work of these men con-

stitutes a true system of dispatching gas to meet the consumers' demands.

HEATING VALUE OF THE GAS. Just as there are high and low grade materials of any kind so there are high and low heat gases. The heating value of the gas is measured in British Thermal Units (B. T. U.). One B. T. U. is the amount of heat required to raise one pound of water one degree Fahrenheit temperature. The standard of manufactured gas for the gas companies of California has been set by the Railroad Commission at 550 B. T. U. after an exhaustive investigation by a joint committee composed of representatives of the Commission and the Gas Companies. This standard was chosen upon the basis of giving to the consumer the greatest value for his money under the present methods of manufacture and for the materials now available. A certain liberty is allowed in fluctuations, provided the average of the gas delivered to the consumer is standard. Wide fluctuations in heating value are detrimental to service and result from inefficient operation. Test stations are provided in the plants and at the center of the distribution system. The aim is to use the plant tests for control purposes in the operation of the generators and the tests at the distant stations as a check upon what the consumers actually receive.

Two methods are used for determining the heating value of the gas. One is, by the use of an automatic and recording apparatus in which a small jet of gas is burned continuously. The gas and air used for combustion are measured by positive meters. A third positive meter measures the flow of a stream of air which passes around the burner where it absorbs the heat given off by the combustion. The three meters are driven by a single motor and are so geared that they must operate in unison. The rise in temperature of the heated stream of air is determined by electric resistance thermometers. This rise is transferred to B. T. U. units and recorded by electrical instruments. The record is continuous. No operator is required except for periodical maintenance and adjustments. The second method is by the use of the Hinman-Junkers Calorimeter, which is of the standard type that has been used for gas calorimetry for several years. With this apparatus the metered gas is burned at a uniform rate by an especially designed Bunsen burner within a combustion chamber. This combustion chamber is enclosed on all sides except the bottom by a water jacket. The products of combustion pass from this chamber at the top, downward through condenser tubes in the jacket and out through a damper flue. Water flows through the water jacket at a constant rate and absorbs the heat from the combustion products. The rise in temperature of the water is read direct from special mercury thermometers made and calibrated for this apparatus. The water used during the test is weighed and the amount of heat absorbed is calculated as the product of the number of pounds of water multiplied by the rise in temperature. This calorimeter requires an operator. A number of control tests are made upon the gas direct from the mains, while the remaining tests are made upon a sample drawn continuously over a twenty-four-hour period.

Upon our system there are six of the automatic recording calorimeters and twenty-four of the Hinman-Junkers type. The total number of tests, exclusive of those made by the automatic calorimeters, is ninety-six per day. If these were conducted at one central station, it would require three operators working eight hours per day. Since the gas distributed is sent out from sixteen different plants into some twenty separate districts this work is actually distributed among several employees. Each plant operates under a close check so that it is possible to deliver a uniformly standard heating value in the gas to the consumers in all districts.

IMPURITIES. In the larger plants where complete chemical laboratories can be maintained the oil from which the gas is to be made is tested as soon as received in order that oil containing too high a percentage of sulphur may not be used. In all of the plants daily tests are made upon the gas leaving the plant for hydrogen sulphide, and at eight of the sixteen plants organic sulphur in the gas is determined. This work is largely technical and is combined with control work within the plant.

The larger plants in San Francisco and Oakland have very well equipped chemical laboratories. Four of the medium sized plants are partially equipped, while the smaller ones make only simple chemical tests. The combined service tests upon im-

purities in the gas and oil would require the services of six chemists. These three phases, namely, pressure, heating value and purity constitute only the physical factors of our company's gas service. "Pacific Service" means much more than simply delivering a product in ample quantities and of standard quality and purity. It means so much more that these three fundamentals are often taken as a matter of course. The modern conception of the meaning of "service" has absorbed the public's attention to such an extent that it is possible they do not realize the clocklike precision and exactitude required to perpetuate the standards of a public utility service.

In order to simply check and test the physical side of the gas service the equivalent of the full time of nineteen employees is required. Naturally the importance of any branch of work is often measured by its size or number of employees. This work is not of any special magnitude, neither does it involve a very large number of employees, but its importance is far in excess of any such standards of measurement. It bears a similar relation to our service as does the guard to a large army. The guard is a small part of the entire army but it must be alert and always at its post. In order that the high standard of "Pacific Service" be maintained, these workers are kept at their post with proper instructions and full equipment. They realize that there are few duties more exacting, more vital, and they are attempting to protect the physical side of our service against the entrance of a single detracting agent.

Young Women of "Pacific Service" Assist in Ceremony

A ceremony believed to be unique in the history of the gas industry in California was performed at San Jose Gas Works on Wednesday, June 4th, when a corps of about 100 young women stenographers, bookkeepers and clerks in the employ of "Pacific Service" manned the jacks which lowered the 200-ton steel base of the company's new 3,000,000 cubic feet gas-holder into position.

The ceremony attracted considerable public attention, hundreds of residents of the Santa Clara Valley being present, including city and county officials, engineering students from Stanford and Santa Clara universities, senior classes from nearby public and private high schools, and others interested. For thirty-three minutes the young women moved in time to the beat of Chief Construction Foreman A. F. Burke's hammer, and it was estimated that each in that time handled two tons of steel. The distance of lowering was two and one-half feet. Several company officials were present, also Mr. R. N. McBride, Field Engineer for the Bartlett-Hayward Company of Baltimore, contractors for this latest addition to "Pacific Service."

The steel base meaures 177 feet in diameter and, as stated, weighs 200 tons. The holder when completed will be 176 feet in height and will have a capacity of 3,000,000 cubic feet of gas. In connection with this work there has been recently added to the gas manufacturing capacity of San Jose Works a new oil-gas generator of 150,000 cubic feet per hour capacity. This construction work, with the installation of an 8-inch tie line between San Jose and Sunnyvale, will enable our company to supply gas to consumers all along the peninsula north of San Jose as far as Palo Alto. Consumers at the latter point will thus enjoy two sources of supply, as they now receive gas transmitted at high pressure from the Potrero plant in San Francisco.

Gas Men of the P. C. G. A. Study Problems in the Southland

Men of the gas industry came from all parts of the Pacific Coast territory to attend the southern sectional gathering of the Pacific Coast Gas Association in Los Angeles, July 11 and 12.

This was the last sectional meeting on the association's program of activities prior to the annual convention which will be held in Santa Barbara during the third week in September. Last January the association held a reunion in San Francisco, and in April the men of the gas industry were called together in Seattle, so that the important points of the compass have been touched and every attention paid to the various problems that confront the gas industry on the Pacific slope. These sectional gatherings have been found of the utmost value to the industry, seeing that they enable gas men to keep in touch with one another not only at central headquarters but points outside, thereby stimulating the general interest and helping to swell the membership roll to proportions not even dreamed of when the P. C. G. A. first saw the light of day thirty-one years ago.

Business sessions were held both days. They were presided over by Mr. Harold Basford, the present chief executive of the Association, and attended by members of the executive committee and heads of the major standing committees. Reports were received and discussed and the slate cleaned, so to speak, for the annual convention so near at hand. An important subject of discussion was the proposed reorganization of the Association through a revision of its constitution and by-laws. It is proposed thereby to re-arrange the Association membership into classes and to put the direct management of Association's affairs into the hands of an Executive Secretary who shall devote his whole time and attention to the work at permanent headquarters in San Francisco and with such clerical help as may be needed.

Early in June the announcement was made that permanent headquarters had been selected in the Wells Fargo Building, San Francisco, under an Assistant Secretary, Mr. Clifford Johnstone, a gas man from the Southland. Mr. Johnstone is well qualified for the work he has undertaken. He has had experience in hydraulic engineering and as editor of a trade journal. He was a member of the engineering staff of the California State Railroad Commission for four years and is thoroughly trained in civil engineering. He knows the technical side of the gas business, is well acquainted with a vast number of gas men in the industry, is familiar with gas utilities and their problems. So, the Association may be congratulated upon securing his services. It goes without saying that when the plan of re-organization is adopted Mr. Johnstone will be invested with the title of Executive Secretary.

Another matter disposed of at the business session was the adoption of final arrangements for the Santa Barbara convention which will be the thirty-first annual gathering of the P. C. G. A. since its inauguration in 1893. It will be called together the afternoon of September 15th and will sit during the balance of the week. On account of the increased interest in the different branches of the gas industry whose representatives make up the personnel of the Association, it has been decided to hold parallel sessions this year. There will, of course, be the usual program of entertainment and, as is customary upon such occasions, the golf tournament will attract general interest.

Probably the most important feature of the gathering in Los Angeles was the technical session held on the afternoon of July 12th in the new headquarters building of the Southern California Gas Company at Tenth and Santa Fe streets. Papers of an unusually interesting character were presented by Messrs Harry L. Masser, formerly gas engineer of the State Railroad Commission and now in the employ of the Los Angeles Gas and Electric Corporation, and Charles M. Grow of the Southern California Gas Company. Mr. Masser's paper dealt with the reforming or "cracking" of natural gas, a practice adopted by gas com-

paines in the southland, particulary in Los Angeles and Santa Barbara. This reforming process consists of a breaking up of the natural gas into a gas whose characteristics are similar to those of manufactured gas. The natural gas is put through regular oil gas generators and subjected to a temperature of approximately 1800 degrees Fahrenheit, the result being a product of lower heating value than natural gas but of largely increased volume. The process described is unique to California and the results obtained are so beneficial as to be of interest to the gas industry everywhere.

Mr. Grow's paper was on the activities of gas companies in promoting industrial gas sales. It was, in effect, a history of this phase of the business from the beginning and showed the vast strides made by the companies in calling general attention to the value of gas as an industrial fuel.

The gathering closed on the evening of July 12th with a banquet at the Hotel Alexandria in Los Angeles at which the assemblage numbered 314, an unusual turnout for a sectional occasion. There were two leading speakers on the program. First came Professor C. A. Gummere, Lecturer on Commerce in the University of Southern California, who entitled the subject of his address, "Knowing." In this he made the point that education was the main factor in any successful career. Knowledge he regarded as a common medium of exchange, while education was like a pipe leading down to an oil well through which the oil was reached and piped to the surface. Statistics showed that 80 per cent of the positions of trust in the United States were held by college bred men, and Professor Gummere quoted several men of world prominence upon the value of learning, including Kant, who said, "Man becomes man only by process of education." Edmund Burke, who declared that education was the chief defense of the nation; Knox, who was quoted as saying, "Every scholar is something added to the wealth of the universe;" Humboldt, who declared that "What you would put into the State you must first put into the schools;" then, coming to the present day, H. G. Wells, who said, "History is a race between education and disaster," and Roger Babson, the well-known publicist, who said: "We insure our houses, our factories, but the same amount invested in a Christian education will achieve greater results."

Professor Gummere presented his points in hammer-like fashion and made a deep impression. He was followed by Mr. James W. Foley, poet, humorist and newspaper man in active service, who in his quaint, original fashion preached the gospel of optimism. His was the doctrine of happiness, with the advice "Do something useful and be happy in the doing of it." Upon the subject of public relations for the public utility and the gas industry generally he presented this word of a world philosophy:

"Once you have established the basis of friendly understanding you have built a highway along which you can walk to the hearts of the people."

President Harold Basford has reason to congratulate himself upon a most successful gathering, one which augurs well for the success of the Santa Barbara convention. It is of interest to know that the P. C. G. A. which has started from small beginnings now numbers approximately 880 men, including representatives of every branch of the gas industry on the coast. The present working organization of the association consists of the following: President, H. R. Basford; Vice-President, E. L. Hall; Secretary-Treasurer, W. M. Henderson; Assistant Secretary, Clifford Johnstone; directors, Wm. Moeller, A. B. Day, M. R. Thompson, W. S. Yard, C. B. Babcock, L. M. Klauber, Van E. Britton. Following are the standing committees:

Meetings Committee: E. L. Hall, chairman; Arrangements Committee, Norman R. McKee, chairman; Publicity Committee, F. S. Myrtle, chairman; Experience Committee, John Clements, chairman; Technical Committee, W. S. Yard, chairman; Commercial Committee, L. F. Galbraith, chairman; Public Relations Committee, D. C. Ray, chairman; Accounting Committee, C. W. Platt, chairman; Membership Committees, W. M. Duggan, chairman northern section; Fred Champion, chairman southern section, F. U. Naylor, chairman central section.

In the Cause of the Public Service--The Pacific Coast Electrical Convention at Coronado

By FREDERICK S. MYRTLE

"Public sentiment is everything. With public sentiment nothing can fail; without it nothing can succeed. Consequently, he who moulds public sentiment goes deeper than he who enacts statutes or pronounces decisions."

Words of wise counsel spoken by Abraham Lincoln in the long ago, and bearing just as important a message in the present when quoted by Colonel A. H. Griswold, vice-president and general manager of the Southern California Telephone Company, at the Public Service Conference that was one of the leading features of the eighth annual convention of the Pacific Coast Electrical Association this year.

One might go further and declare that the words of Abraham Lincoln and others of similar import constituted the slogan or watchword of this, considered the most successful convention of electrical men so far held on the Pacific Coast. The problem of public relations had place in discussions upon every phase of the electrical industry. Without doubt, in order to reach the goal of ultimate success the electrical industry, like every other public service enterprise of today, must walk hand in hand with that public confidence which can be attained only by the establishment of relations of mutual understanding between the public utility and the public it serves.

The convention was held at Coronado during the third week of June. An attendance of 450, including delegates from the remotest sections of the Pacific slope, faced President L. M. Klauber at the opening session. Coronado is truly a delightful recreation ground, where the sun shines most days in the year and light, refreshing breezes blow in from the Pacific ocean. Then, there were unusual features in the convention program that served to attract. The Public Relations session, for instance, brought out a number of speakers who discussed this most important problem from various angles, with the result that the session was of real value to the electrical industry, particularly from the public utility standpoint. Another session of great value was the Public Service Conference, which took the place of the Western Development Conference that was the leading feature of last year's convention and at which the subjects discussed ranged over the entire field of the public service in its personal and political relations. Last, but not least, for the first time in the history of the industry the women guests of the convention were given a session all their own which proved quite a feature in itself and is due for regular recognition from this time on as a part of the convention program. More than fifty women attended and displayed keen interest in the affairs of the association and in the electrical industry as a whole.



L. M. Klauber, retiring president of the Pacific Coast Electrical Association

President Klauber opened the business of the convention with an address in which he emphasized the great benefit to the industry as a whole from gatherings like the present, at which not only the men of the public utilities but, also, their brethren engaged in other branches of the industry were given an opportunity to meet and exchange ideas. He advised closer co-operation between the Pacific Coast Electrical Association and sister organizations, such as the Northwestern Light and Power Association and the Pacific Coast Gas Association. He suggested that representatives from each of these be present at the several conventions. This latter suggestion is along up-to-date lines and looks worthy of acceptance upon the theory that in the public service there is a community of interest between the various industries engaged.

The report of the Public Policy Committee, always an attractive feature of these gatherings, was presented by Mr. W. L. Frost, of Los Angeles, in the absence of the chairman, Mr. R. H. Ballard. The report treated of public relations, co-operative organization, customer ownership, and other matters of immediate concern. Upon the first subject the report said:

"Satisfactory public relations depend mainly on two things, first, that one who wishes the friendship of the public must get it by performing real service to the public; second, that the public must realize that such service is being rendered at the very minimum of cost.

"Our own electric light and power business is rendering its service upon the smallest possible basis of return, i. e., for the bare wages of the capital invested in service. We have no voice in fixing the current rate of wages of capital; those wages are fixed in the open market. Capital always has the option of engaging in our business, under this strictly regulated limitation, or of entering some one of the hundreds of unregulated industries where there is no limit. The advantages we can offer come from the safety and stability accompanying careful and efficient management of this necessary business."

Upon the subject of "political ownership" the report said: "Municipal ownership agitation seems to be losing ground. In the whole United States, out of upwards of 2,300 municipal electric enterprises that have been attempted at one time or another about one-third have gone out of existence, or have become customers of utility companies. Of those municipal enterprises that remain only a handful are regarded as successful—even by enthusiasts—and this handful must depend mainly either upon concealed drafts on the taxpayers, or upon constantly greater and greater construction expansions to conceal their real situations."



K. E. Van Kuran, general convention chairman

The report attacked tax-exempt securities as furnishing the means by which municipal enterprises shift their costs upon taxpayers without the taxpayers' knowledge. "They hamper industry and promote stagnation and decay. They encourage political extravagances and conceal from the public the real cost of those extravagances—for which the public must pay."

At the Public Relations session, Mr. R. E. Fisher, Pacific Gas and Electric Company, San Francisco, presided. Mr. M. H. Aylesworth, managing director of the National Electric Light Association, who always comes from the East to attend the P. C. E. A. convention, delivered an address entitled "The Case Against Political

Ownership." He showed up an array of erroneous statements made by the Public Ownership League and other sources of public ownership propaganda, particularly in their advocacy of a government-owned superpower system consisting of municipally owned and operated electrical plants. He presented figures to show that these plants represent about four per cent of the electrical output of the nation, while approximately ninety-six per cent is produced by privately owned systems. He contended that about eighty per cent of the municipal plants would immediately cease to exist under a superpower system, not merely on account of their inefficient political management but because their equipment is for the most part obsolete and not capable of being taken into any superpower system. Another interesting fact brought out by Mr. Aylesworth and not given publicity by the proponents of so-called public ownership is that fifty per cent of the generating capacity of the company systems is employed in generating power for the industries, also that ninety-eight per cent of all industries in the country purchase their power from company systems while just two per cent purchase from municipal plants. Mr. Aylesworth quoted several men of distinction upon this public ownership question, as, for instance, Chief Justice Taft, who said:

"The intervention of politics always increases the cost of operation, and leads to unwise management. Many who favor municipal operation admit that the present system cannot be continued by municipal and state governments without a constant loss. They propose that the losses be made up by taxation. But our experience in public control of that kind of activity and complicated business management has not been fortunate. It foreshadows such lack of economy and increase of cost of operation as to make the change most unwise."

Secretary Hoover was quoted to the following effect: "We have outdistanced all the world in electrical development. Invention and industry have developed so that despite the increase in cost of labor and material the cost of power is very little higher than during the pre-war period. I have no taste for government operation and distribution of electrical power. The talk about it is generally due to a lack of understanding of the practical aspects of the industry."



R. E. Fisher, chairman of the Public Relations session

Another paper which engaged popular attention was that by Mr. R. E. Smith, Southern California Edison Company, Los Angeles, on "Common Sense in Public Relations." In this the writer aimed to bring out the weaknesses in the electrical industry's present public relations structure and, at the same time, to offer definite and concrete suggestions as to how to overcome those weaknesses. He voiced the opinion that the real basis of public relations lies in getting along with the public as individuals rather than as a mass. He held that public attitude changes as individual attitude changes, so that by aiming to create a better individual feeling toward the public utility the feeling of the mass is bettered far more effectively than by direct appeal to the mass. Group antipathy disappears with individual good will.

At the Public Service Conference, over which Mr. Frank A. Leach, Jr., Pacific Gas and Electric Company, San Francisco, presided, a feature address was presented by Mr. Henry Swift Ives, Secretary, Casualty

Information Clearing House, Chicago, on the subject "Public Service and Public Ownership." In dealing with this much discussed subject Mr. Ives emphasized the fact that political government and industrial government are two separate fields and should be kept as far apart as possible. Though they may overlap in places, under a democracy they can never merge without, at the same time, destroying that vital thing, democracy. His definition of government ownership is worth quoting in full:

"Government ownership of industry may be defined as the substitution of government deficits for private profits. It is taxation for confiscation. It is the first and last step in the socialist seduction of democracy. It pretends to take away from those who have for the benefit of those who have not, but in reality it takes away from all to the injury of all. It is an attempt to subsidize mediocrity by penalizing genius, but actually the only effect of such a subsidy is to make mediocrity even more mediocre. It represses the reproductive processes of capital, and then tries to revive them by a tax gland operation. It is destructive of wealth growth and productive of debt growth. It makes politics instead of business the national dividend producer. It promotes waste and demotes saving. And, its whole tendency leads directly to the ultimate absorption by the state of all private property rights. Government ownership spells the socialist millenium if carried out to its logical conclusion."

To all business men Mr. Ives addressed an appeal for zealous activity in combating public ownership. He suggested the organization of a Private Ownership League. "I see no reason," he said, "why such a move might not be feasible. The socialists have a Public Ownership League, which is a heavily subsidized going concern and, unfortunately, has among its membership many business men and property owners who have been lured by its fake altruistic appeals, or who have been misled by prejudices or biased by selfishness. Why, indeed, should not the property-owning classes, representing a large majority of the people of this country and nearly all of its wealth, have a league to safeguard their interests against malicious and insinuating socialist propaganda?"

The community of interest idea was illustrated in the appearance at this conference of Colonel Griswold, representing another industry, that of the telephone. He talked on "Public Service and Financing." He outlined the progress made by the public utilities in customer and employee ownership, and declared that successful financing of these utilities is dependent upon good service, proper internal relations, proper relations with other utilities and proper relations with the public.



Frank A. Leach, Jr., the new president of the Pacific Coast Electrical Association

On the subject of "Business Service and Competition" Mr. Ben S. Allen, representing the Key Route System, Oakland, declared his belief that competition is not the life but the death of trade. The only competition left the utilities since they have been placed under the jurisdiction of regulatory bodies is that of service.

Mr. C. P. Cutten, Pacific Gas and Electric Company, San Francisco, spoke along similar lines in an address entitled "Public Service and Utility Co-operation." He thought the companies had made great headway toward the establishment of proper public relations, but he recognized that it was an endless struggle. "We may

be called upon to give more and more," he said. "But we are making friends and we are going to keep them. Our problem will be less serious, we will have more and more support and will be more and more trusted."

Lack of space prevents anything approaching a complete report of these most interesting sessions. Another matter worth mentioning was the action of the Publicity Committee in submitting a new plan of organization, calling for the establishment of a News and Advertising Section, subdivided into various bureaus for the purpose of studying and reporting on the many problems involved. The section held two sessions during the convention, where papers were read and discussed. This section bids fair to be recognized henceforth as an important division of the Association's activities.

The Technical, Commercial, Purchasing, Accounting and Personnel sessions were all well attended. Reports of various bureaus and sub-committees were presented and discussed. Electric trucks, electric signs, improved residence lighting, improved electrical equipment and appliances, were among the important subjects under consideration. The discussions of the Commercial section indicated a need for better merchandising policies for central stations and closer co-operation between merchandising agencies.

The convention closed with a banquet at which Mr. C. T. Hutchinson, McGraw-Hill Company, San Francisco, acted as toastmaster. The two speakers were General G. H. Harries, vice-president of H. M. Byllesby Company and general manager of the San Diego Consolidated Gas & Electric Company, and Chester H. Rowell, former newspaper publisher and former member of the State Railroad Commission.

There was the customary program of entertainment during the week. This included luncheons, teas, concerts, dinner and theatre parties, dancing, tennis and golf tournaments. It was a delightful outing all around, at which work and play were mingled to the general benefit. An innovation in the order of procedure was the report of the nominating committee on the first, instead of as formerly, on the concluding day of the convention. The following will rule the destinies of the P. C. E. A. for the following twelvemonth:



Samuel H. Taylor, secretary P. C. E. A.

President, Frank A. Leach, Jr., Pacific Gas and Electric Co., San Francisco; Vice-Presidents, William Baurhyte, Los Angeles Gas and Electric Corp., Los Angeles, and S. Waldo Coleman, Coast Counties Gas and Electric Co., Santa Cruz; Treasurer, J. F. Pollard, Coast Valleys Gas and Electric Co., Salinas; Secretary, Samuel H. Taylor. Executive Committee—James B. Black, Great Western Power Co., San Francisco; Harry Harper, Western Electric Co., Los Angeles; R. M. Alvord, General Electric Co., San Francisco; A. M. Frost, San Joaquin Light and Power Corporation, Fresno; K. E. Van Kuran, Westinghouse Electric and Manufacturing Co., Los Angeles; W. L. Frost, Southern California Edison Co., Los Angeles; F. O. Dolson, Southern Sierras Power Co., Riverside; L. M. Klauber, San Diego Consolidated Gas and Electric Co., San Diego; P. M. Downing, Pacific Gas and Electric Co., San Francisco; Clyde Chamblin, California Electrical Construction Co., San Francisco; R. J. Holterman, Fobes Supply Co., San Francisco; C. T. Hutchinson, McGraw-Hill Co., San Francisco.

The Financial Side of "Pacific Service"

Following is a statement of the Company's Income Account for the month of June and the six months ended June 30, 1924:

	MONTH OF JUNE	SIX MONTHS TO JUNE 30, 1924
Gross Revenue, Including Miscellaneous Income	$3,712,278.97	$22,193,595.66
Maintenance, Operating Expenses, Rentals, Taxes (including Federal Taxes) and Reserves for Casualties and Uncollectible Accounts	2,338,088.90	13,731,717.18
Net Income	$1,374,190.07	$ 8,461,878.48
Net Interest Charges	549,517.65	3,200,442.86
Balance	$ 824,672.42	$ 5,261,435.62
Bond Discount and Expense	32,236.59	182,104.58
Balance	$ 792,435.83	$ 5,079,331.04
Reserve for Depreciation	263,676.60	1,605,930.99
Balance to Surplus	$ 528,759.23	$ 3,473,400.05

Our estimates made earlier in the year indicated that gross operating revenues (excluding Miscellaneous Income) would run in excess of $44,250,000 for the entire year. This would be an increase, compared with 1923, of something like four and a quarter million dollars. The results for the first half of the year, slightly under twenty-two million dollars, would seem to indicate that our expectations will be realized.

An additional index of the continuation of our rapid growth is the fact that between January 1 and June 30, 1924, the number of active meters increased by 23,319, making a total of 733,354 in service at the close of June. The net addition of meters in the twelve months preceding June 30, 1924, was 65,903. In both the six months' and the twelve months' period, the additional new customers exceeded the unusual growth which we experienced in the same periods of the preceding year.

In the six months' period the increase in operating costs directly traceable to the statewide water shortage exceeded $1,300,000, but owing to the larger volume of business, the practically undiminished supply of hydro-electric energy from our new Pit River plants and the observance of economies wherever possible, we were able to earn $5.20 per share for our Common Stock, or but slightly less than the amount earned in the first six months of last year.

While drought conditions have compelled curtailment in the use of electric energy in other sections of the State, we are supplying all demands of our customers in full and taking care of any new business offered. Our fortunate situation in this respect is not accidental, as we have expended to date something like twenty-six million dollars in the construction of stream flow plants on the Pit River. These plants are operating at practically normal capacity in spite of the unusually dry season. We have also expended approximately one million dollars for an 18,000 horsepower steam turbine in Sacramento, which was placed in service on June 17, 1924. A number of isolated steam plants have also been connected to the system. We expect to give full service to all of our customers during the remainder of the year, or until such time as the usual Fall rains relieve the present situation.

EMPLOYEE-STOCKHOLDERS

At the present time 3,789 employees are also stockholders. Their holdings, including subscriptions on which payments are being made, aggregate $3,601,500, or an average of 9½ shares each, and include $2,091,000 of Preferred and $1,510,500 of Common Stock. Among these employee-stockholders, who by their thrift, have advanced themselves to the position of being part owners of the property, no less than 1,480, or 39 per cent of the total, are working for daily wages. This distribution of ownership among the men and women who form a large and integral part of the Company's organization, not only evidences confidence in the Company by those in the best position to know all about it, but is bound to add to the efficiency and economy in the conduct of its affairs through the self-interest naturally associated with ownership.

The following table, showing the occupations of our employee-stockholders, presents a pretty fair cross-section of our entire organization and, incidentally, conveys some idea of the ramifications of the Company's business, fifty-five distinct classes of employees being here represented.

OCCUPATIONS OF EMPLOYEE-STOCKHOLDERS

Accountants and Bookkeepers	102	Hydrographer	1
Adjusters	7	Janitors	19
Agents	66	Laborers	523
Attorneys	11	Librarian	1
Blacksmiths	15	Line Inspectors	2
Boilermakers and Cleaners	26	Mappers	11
Cashiers	23	Matron, Lunch Room	1
Carpenters	35	Mechanics	129
Chauffeurs	5	Meter Readers, Testers, etc.	137
Chainmen	7	Oilers	37
Clerks	521	Painter	1
Cooks	6	Pensioners	30
Collectors	77	Pipe and Gas Fitters	107
Comptometer Operators	13	Plumbers	2
Conductors and Motormen	20	Power House and Substation Operators	213
Doctor	1	Printers	2
Draftsmen	113	Rigger	1
Electrical Workers, Linemen, etc.	359	Salesmen	55
Elevator Operators	5	Stenographers	110
Engineers	197	Storekeepers, Warehousemen, etc.	25
Estimators	8	Surveyors	11
Executives	10	Telephone Operators	24
Firemen	57	Teamsters and Truck Drivers	63
Foremen and Superintendents	367	Timekeepers	18
Gas Makers	39	Traveling Auditors	4
Groundmen	63	Waiters	2
Gardener	1	Watchmen and Patrolmen	38
Heads of Departments, Division and District Managers, etc.	68	Total	3,789

AN EXPRESSION FROM THE NEW YORK EVENING POST

In a copyrighted article appearing in its issue of July 19, 1924, the "New York Evening Post," founded in 1801, nationally known and highly esteemed among investors by reason of the outstanding quality of its financial news and reviews, has the following to say under the caption:

"Pacific Gas and Electric Company Issues an Annual Report Which Represents Another Milestone in its Long Record of Continuous Progress"

By PAUL WILLARD GARRETT

Annual reports mean very little to most people, including the thousands of power and light customers who, by their purchase of Preferred Stocks, have become partners in the typical public utility company. Most of these investors have not ever made an analysis of an annual report. They are not schooled in the technicalities.

Many companies are beginning, however, to interpret the figures by descriptive matter, to intersperse pictures of the properties and to substitute simple language for the technical terminology of former statements. To some hard-headed bankers some of these newer reports are irritating, especially where the balance sheet and income accounts are buried in the back of the pamphlet. To them the balance sheet is fundamental and the general remarks incidental. The Pacific Gas and Electric Company, one of the foremost electric power and light organizations of the world, and one in which both customers and bankers are widely interested, has managed to strike a happy medium in the arrangement of its report for 1923.

Mixes Discussion With Tables

The report is not merely a compilation of statistical tables, nor is it a general discussion of the year's events to which an appendix of tables is added; the discussion and the tabulations are woven together. The plan is excellent.

One of the first things to appear in the report is the analysis of the income account. The usual details are given, but are made interesting by comparisons. Gross operating revenue reached $39,321,536, a new high record. These revenues have shown a gain in every year since 1905, when the company was incorporated. The gain in gross was all the more remarkable in that it came despite 1923 rate reductions representing about $2,500,000 in electric and $970,000 in gas revenues.

It is interesting to note the sources from which the gross of this great hydro-electric enterprise is derived. In 1923 approximately 61 per cent came from the sale of electricity, 34 per cent from gas and 5 per cent from minor activities such as the street railway system of the City of Sacramento.

Where the Customer's Dollar Goes

After itemizing its gross revenues of $39,321,536, the company makes some impressive tabulations of expenditures. In a study of the traction industry in this column a few days ago it was pointed out that labor costs consume nearly half of traction gross revenues. It may be noted that wages also absorb more of the gross than any other item in the case of Pacific Gas and Electric Company. However, wages in 1923 took only 25 per cent of the customer's dollar. Materials and supplies other than oil took over 12 cents. The company makes an index of the cost of materials and supplies used by it, and this compilation for 1923 stood 5.3 per cent higher than in 1922. More than 10 cents of each dollar went for taxes, an item that has increased 126 per cent since 1918. Three-fourths of the taxes went to the State of California.

Plowing the Money Back

Bond interest in 1923 absorbed 15.7 cents of each dollar of gross operating revenue and the amount left for common stockholders, after payment of all other charges, including depreciation and preferred dividends, represented 9.3 cents on each dollar of gross. The balance of $3,652,447 available for the common stockholders may be looked at from several angles. It represents 9.3 cents on each dollar of gross operating revenue, $10.30 per share on the Common Stock and 1.58 times the cash dividend requirements.

Interest charges were earned 2.67 times in 1923. During no year in the last ten have they been earned less than twice. Few, if any, companies have achieved greater success in the sale of their preferred shares. In less than a decade the Pacific Gas and Electric has sold $43,500,000 of Preferred Stock, largely among its own customers and for cash. One reason that Pacific Gas and Electric securities are so sound is that the company has plowed earnings back into the property for a long time. Aggregate gross revenues of $381,624,507 have been received during the last eighteen years; of this, $90,395,524 represents the balance shown after the payment of fixed charges. But only $33,925,000 of this amount, or 37 per cent, actually has been paid out in cash dividends, the remainder having been retained in the business.

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF
A. F. HOCKENBEAMER - BUSINESS MANAGER

Year's subscription $1.50
PACIFIC GAS AND ELECTRIC COMPANY
445 Sutter Street, San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVI JULY, 1924 No. 1

EDITORIAL

Commencing with the present number, PACIFIC SERVICE MAGAZINE *henceforth will be issued as a quarterly instead of, as heretofore, a monthly publication.*

This course has been decided upon after due consideration. As our readers by this time are well aware, it is the consistent policy of our company to afford the fullest information concerning its activities in every branch of its working organization. For some years PACIFIC SERVICE MAGAZINE *has served as a connecting link in this respect between the company, its stockholders and the public it serves, and it has come to be regarded as furnishing to its readers an imperishable record of the company's advancement hand in hand with State development. This record each month has been laid before the company's stockholders and a considerable number of leading citizens in various phases of public life, with, of course, the customary distribution among employees.*

In the beginning of 1923 a new publication bearing the P. G. & E. trademark made its initial bow to patrons of "Pacific Service." This was given the title "P. G. & E. Progress." Its purpose, as indicated in the foreword inscribed by President Creed, is to establish itself as a journal of fact, noting for the public benefit the happenings of the moment in the various sections of our "Pacific Service" territory, so as to keep the many hundred thousand consumers of our company's commodities in intimate touch with the news concerning the conduct of the company's business, particularly in regard to extensions and improvements of service. This new publication, then, circulates among the company's consumers as well as its stockholders and employees and is to be regarded as distinct in its purposes and aims from PACIFIC SERVICE MAGAZINE *which, since its inauguration in 1909, has steadily grown in favor among its patrons as a special feature publication.*

In continuing PACIFIC SERVICE MAGAZINE *as a quarterly, the purpose is not only to retain its high quality as a house journal but, if possible, to place it upon a yet higher level. It is to be regarded then, as a periodical of strictly feature order in which our company's major activities will be presented in the most graphic and attractive manner possible to its many thousands of readers at home and abroad who by this means have been enabled to trace our company's progress through the years of its development and who, we feel sure, will continue to manifest both keen and kindly interest in every phase of its endeavor as a public utility of the first rank.*

On Monday, June 2, the Supreme Court of the United States rendered a decision sustaining the appeals of the Pacific Gas and Electric Company in three suits brought against the City and County of San Francisco to enjoin the enforcement of ordinances fixing a maximum rate of seventy-five cents per thousand cubic feet for gas for the three fiscal years beginning on the 1st day of July in 1913, 1914 and 1915. By this decision, the decrees of the United States District Court, which had declared the contested ordinances to be constitutional and valid and had ordered the company to repay to its customers all sums of money theretofore collected from them in excess of the amounts authorized by the ordinances, were reversed, and the cases sent back to the District Court for re-trial.

The aggregate amount of the sums of money which the company had been directed by the decrees of the District Court to refund to its gas consumers was $1,472,561.47, plus interest accrued at the rate of seven per cent per year from the dates of collection.

During the fiscal year ending June 30, 1913, the company had complied with an

ordinance fixing for that year in San Francisco the rate of seventy-five cents per thousand cubic feet for gas. The company's net earnings from its gas business in San Francisco during that year amounted to approximately five and one-third per cent of the value of its property used in that business, as subsequently appraised by the District Court. The company, being convinced that this return was inadequate and that the same maximum rate fixed by ordinance for the ensuing three years was unreasonable and confiscatory, commenced suits in the United States District Court in San Francisco to enjoin the enforcement of this rate.

By the use of an improvement in oil gas generators and in the process of manufacturing gas from oil then recently invented, the company effected a saving in the cost of gas manufacture in San Francisco amounting to the sum of approximately $103,000 for the year ending June 30, 1914, the sum of $132,000 for the year ending June 30, 1915, and the sum of $258,000 during the year ending June 30, 1916. The Master in Chancery, whose report was approved by the District Court, found that the company's net earnings exceeded seven per cent of the value of its gas properties, for the year ending June 30, 1914, by the sum of $21,402.95; for the year ending June 30, 1915, by the sum of $89,446.12; and for the year ending June 30, 1916, by the sum of $171,464.48.

If the company had not brought into use the new invention, which involved the investment of a little more than $300,000 of additional capital, its net earnings for each of the three years in suit would have been substantially less than seven per cent of the value of its San Francisco gas properties, which the Master appraised at approximately $14,000,000, without including any sum representing the value of its right to use the patented invention. The Master further found that seven per cent was the minimum rate of return that could be considered reasonable and compensatory.

Moreover, it was shown by the evidence that the company, in order to avail itself of the benefit of this new invention, had actually abandoned during the period involved in litigation one gas manufacturing plant, the appraised value of which exceeded $500,000, and contemplated the early abandonment of two other plants, the appraised value of which was approximately $650,000.

The effect of the decrees of the District Court was to take from the company and to give to its consumers the full benefit of the savings in cost of manufacture effected by the company's use of the new invention; in addition, to throw upon the company the greater part of the loss involved in the abandonment of its obsolete gas manufacturing plants.

It was also shown at the trial of the cases that the enforcement of the contested ordinances would have resulted in compelling the company to furnish gas at less than cost, exclusive of any return upon the value of its property, to consumers using less than approximately twelve hundred cubic feet of gas per month. The number of consumers using less than this amount during this period was approximately twenty thousand, or nearly one-fifth of the total number of the company's gas consumers in San Francisco.

The position taken by the company before the Supreme Court was that, under the Constitution of the United States and the laws of the State of California, it was entitled to charge for the gas manufactured and sold by it just and reasonable rates, and that the rate prescribed by the ordinances of the City and County of San Francisco was unjust and unreasonable because its enforcement would have deprived the company of any share in the benefits resulting from its introduction and use of the new invention, would have thrown upon the company the greater part of the loss resulting from the abandonment of its gas manufacturing plants rendered obsolete by the new invention, and would have compelled the company to serve a very large number of its consumers at less than cost. The company further urged upon the Supreme Court that an affirmance of the decree of the District Court would inevitably result in discouraging and retarding the introduction and use of new inventions by public utility companies and would thus, in the long run, be detrimental to the interests of the public.

The decision rendered by the Supreme Court will, in our opinion, result in advantage not only to the company but, also, to its consumers and to all consumers served

by progressive, well-managed public utility companies.

Finance and Trade, a well-established financial review published in San Francisco, in a recent issue commented at some length upon the Supreme Court decision. We present the following excerpt:

"The important point in this decision is not that it gives the Pacific Gas and Electric Company another opportunity to make a fight for some $2,500,000 which would otherwise be refunded to gas consumers. If that were the whole matter involved it would be of comparatively little consequence to anyone concerned. That amount of money is large, to be sure, but in the general scheme of things it does not assume such large proportions. What is important is the emphasis which the Supreme Court has placed on the principle that is embodied in the California Public Utilities Act to the effect that the public utilities should be encouraged to make improvements by being given some benefit of their improvements.

"In this particular case the Pacific Gas and Electric Company and its stockholders would have been materially better off—assuming that the city had finally won its point—never to have improved or cheapened the manufacture of gas; and by the same token the public would suffer by never having improvements made.

"Everyone concerned, the public utility managements, the public and the security holders of the companies, is fairly well agreed on the principle that public regulation of utilities is desirable. It protects the public, on the one hand, by insuring good service at reasonable rates and it protects the companies by insuring them against costly and unreasonable competition. This, in turn, makes it possible for investors to provide the money that is necessary for the constantly enlarging service of the public utilities; that is, it makes it possible for investors to provide this money and, at the same time, be free of worry.

"But the public and all concerned would have purchased this stabilization at too high a price if public regulation were allowed to go to the length of destroying the incentive to improvements and progress. The incentive is financial. The management of the Pacific Gas and Electric Company would be subject to the just blame of their security owners if they allowed another incentive, such as philanthropic desire to improve the world, to rule their actions at the financial expense of the security holders."

Finance and Trade expresses the opinion that sooner or later the effect of this decision will be felt by the same gas consumers who have been led to believe that the order of several years ago against the Pacific Gas and Electric Company was a victory for the people. States the journal:

"One class of the public which has been ignored, second only in size to the entire body of gas users, includes the owners of the bonds and stocks of the public utilities. The direct injury to them is not great. The bond holders have ample security for their investment, as have also the stockholders. The latter might, if the original decision had been sustained by the United States Supreme Court, have lost a small amount of the actual value of each share of stock by reason of the cash disbursement which the company would have had to make. The greatest loss to the stockholders would have been in future accretion to the value of their holdings.

"But this would react on the general body of consumers by discouraging investment in the public utilities.

"In other words, the general consuming public would lose in two ways, first by destroying the incentive to improve and cheapen service, and second by discouraging investment which is absolutely necessary to future improvements."

We call the attention of our readers to Section 20 of the California Public Utilities Act, which reads as follows:

"Nothing in this act shall be taken to prohibit any public utility from itself profiting to the extent permitted by the commission, from any economies, efficiencies or improvements which it may make, and from distributing by way of dividends, or otherwise disposing of the profits to which it may be so entitled, and the commission is authorized to make or permit such arrangement or arragements with any public utility as it may deem wise for the purpose of encouraging economies, efficiencies or improvements and securing to the public utility making the same such portion, if any, of the profits thereof as the commission may determine."

From Power House to Consumer

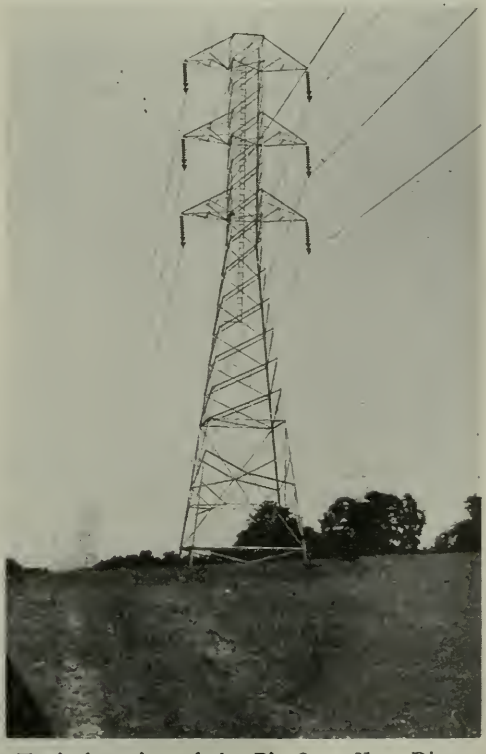
A Brief Discussion of Some of the Problems Encountered in Connection With the Transmission of Power as Generated in the Mountains, and Its Delivery to the Consumer

By S. C. PARDEE, Department of Engineering

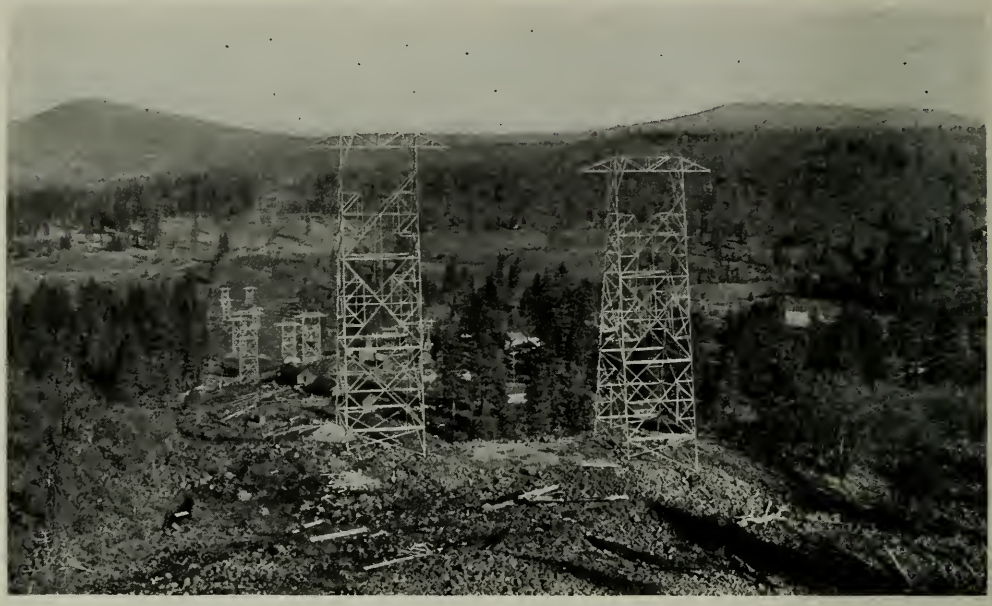
Much has been written of late years descriptive of the large hydro-electric developments being carried out by the power companies of California. This construction has been featured not only because of its economic importance but, also, and perhaps to a greater extent, because of the inherently spectacular nature of the work. One hears of the damming of mountain torrents with concrete structures, 100 feet and greater in height; of the consequent forming of artificial lakes in the mountain fastnesses covering many acres; or of the driving of huge tunnels, often three to five miles in length through the snow-capped ranges of the Sierra Nevadas. Is it then any wonder that when the word "power" is used, the average individual immediately pictures the dam and the lake and the tunnel and, sometimes, the power-house, and lets it go at that? This same individual's mind seems to perform some kind of mental gymnastic which enables him to jump the gap between the power-house and his artificially shaded reading lamp, apparently assuming that, since electricity is such a wonderful thing, it too will obligingly "jump the gap" and report for service, as it were, at the consumer's back door.

Such, however, is not the case. Although our telephone and telegraph friends have more or less succeeded in dispensing with physical apparatus between their generating and receiving stations largely on account of the relatively small amounts of electricity which they utilize, we in the power business, faced with the necessity of economically transmitting large blocks of this mysterious energy, have a much more intricate problem.

For instance, take the case of the power now under development by the Pacific Gas and Electric Company in the Pit River region. This power has long been known of but, due to its great distance from the load centers, was not at first considered economic. However, the growth in load in this portion of the State forced the situation in recent years, for a power company on account of the length of time required for the construction of its mountain developments must forecast the growth in its territory, keeping at least three or four years ahead of actual conditions. Realizing, then, that the power from the Pit would have to be transmitted to the bay region in order to be of the most use, a location near Sacramento between Vacaville and Dixon was selected for the substation at which the initial distribution of this power would be made, as



Typical section of the Pit One—Vaca-Dixon 220,000-volt transmission line crossing the Sacramento valley



Section of the Pit river—Vaca-Dixon line, showing type of towers used in the snow region

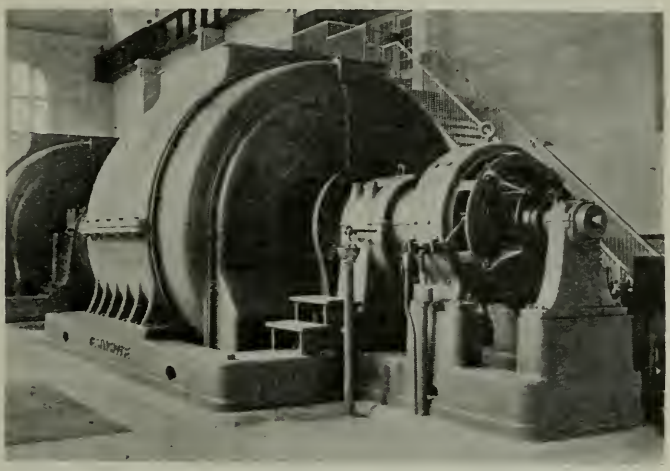
this appeared to be the most convenient location with respect to the existing lines. From this point, called by the company Vaca-Dixon substation on account of the splendid co-operation received from the citizens of Vacaville and Dixon located nearby, it is approximately 200 miles to the Pit River No. 1 plant, which is located a few miles from Fall River Mills. It was found that if the power generated at the Pit was to be transmitted over this distance without prohibitively large losses, a higher voltage or pressure would have to be used in transmitting this power than had up to the time of which we speak been believed commercially possible.

Investigation revealed the fact that the insulators, which are the devices used for the double purpose of supporting the conductor and preventing the precious power from leaking out of this conductor to ground, constituted the weak link in the transmission chain. The intensive research on this subject which was immediately started not only here on the coast but also in the laboratories of the eastern manufacturers is now an old story to those in the business, for to them it was all in the day's work. Suffice it to say, then, that the efforts of the investigators, who numbered in their ranks many of the leading electrical engineers of the country, were finally rewarded by the development of the insulator industry to a point where it was believed



Switch and bus structures for the high-tension transformers and oil switches a Vaca-Dixon substation

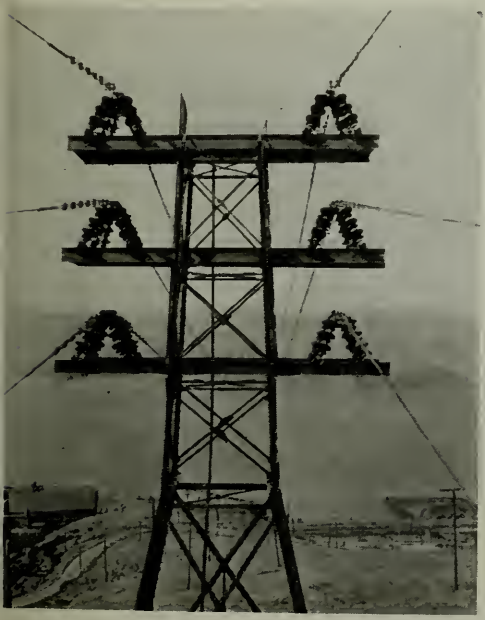
safe to rely on a transmission pressure of 220,000 volts. It was estimated that the Pit power could with this voltage be transmitted to Vaca-Dixon with a loss of only 8 per cent, which was considered satisfactory. This loss figure of 8 per cent, however, was dependent upon our company's engineers being able to maintain the power factor of the lines somewhere near unity. This installation at Vaca-Dixon of two 20,000 K. V. A. synchronous condensers. Now, a synchronous condenser is merely a certain type of electric motor which may be adjusted so as to cause it to take current at either a lagging or leading power factor from the line. Thus, the synchronous condensers at Vaca-Dixon substation may be so adjusted that the power factor of the Pit transmission lines may be held close to unity even though the power factor of the load is much less than unity.



Two 20,000 k. v. a. synchronous condensers installed at Vaca-Dixon substation

From Vaca-Dixon a certain portion of the power was fed into the P. G. & E. system in the Sacramento valley, but the greater portion was of course required in the bay region. It was decided that a voltage of 110,000 would be economically suitable for transmission of the power from Vaca-Dixon to Claremont, which was marked as the distribution point for the East Bay section. Accordingly transformers to step the power down from 220,000 to 110,000 volts were required at Vaca-Dixon, a special 11,000-volt winding being provided for operating the synchronous condensers described above. At Claremont the power was again "stepped down" and fed underground at 11,000 volts to the distributing substations located in the heart of Oakland and Berkeley.

But, what of San Francisco? you say. Is the power brought across the bay in cables? This is the case to a limited extent, but for a large center of population such as San Francisco it was not believed safe to rely to strongly on these transbay cables as they are subject to all sorts of accidents. Accordingly, a portion of the power from the company's system is transmitted around the end of the bay and up the peninsula at 110,000 volts, the stepdown station being located near the Bay Shore highway just across the San Francisco county line. From here the power is transmitted to the distributing substations at 11,000 volts, where it is again stepped down to 4,000 volts or lower, as may be required.



South Tower, on the Contra Costa side of Carquinez straits, where the Vaca-Dixon Claremont 110,000-volt transmission line crosses San Francisco bay



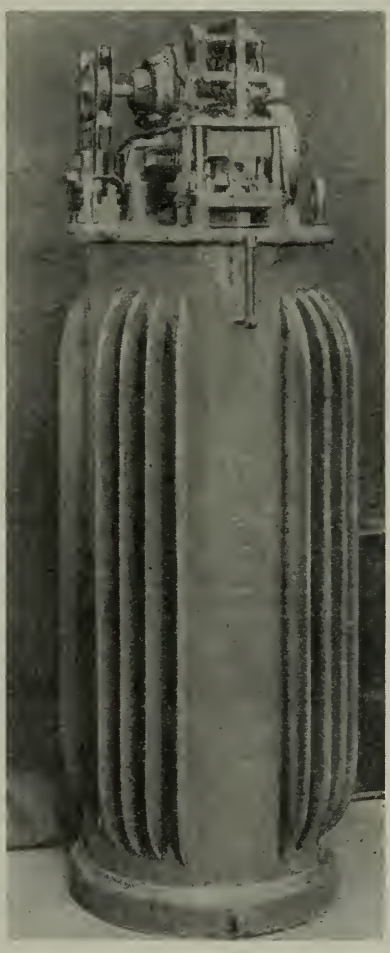
Claremont substation, where the power coming in from Vaca-Dixon substation is "stepped down" for distribution in the East Bay section

But referring back to Mr. Average Citizen's well-shaded reading lamp, which was mentioned in the beginning of this narrative, do not imagine that the power problem as relating to this lamp has been solved when we have reached the distributing substation. Many intricate feeders are required and smaller transformers for stepping the power down to 110 or 220 volts for the consumer's use. These latter transformers are usually located on pole tops or in chambers beneath the street. When one considers the diversified nature of the load which is fed from the substations it is easy to see that the voltage or pressure on the



Induction regulator installation at Station "C," San Francisco

feeders is going to vary considerably as the several portions of the load come off and on. If the pressure gets too high the bulb in Mr. Average Citizen's reading lamp may be burnt out, or if the pressure gets too low his lamp will burn very dimly, either of which contingencies is certainly not to be desired. Happily, a device has been perfected, called an induction regulator, which automatically maintains the voltage on the various feeders between certain specified limits; thus causing the reading lamp before mentioned to burn steadily and with sufficient brilliance for its natural life.



Type 46 k. v. a. 2300-volt induction regulator

The foregoing description outlines very sketchily the various means used in one particular case to bring the power generated in the mountains down to the centers of population where it is most useful. There are many other angles to the problem than those mentioned, however. For instance, consider the long stretches of line coming down from the mountains and the constant danger of breakdown from storms, falling trees and what not. To find the break in such a line and to repair it may take several hours, and yet with the standards of service as they exist today a shut down of a consumer for one-half a minue is considered serious by our operating engineers. How, then, is this service maintained? The answer to this question could well be made the subject of a length article itself, but briefly, it may be stated that the service is maintained, first, by the intelligent use of a large inter-connected system of transmission lines from the various power houses, thus enabling the load dispatcher to shut off the line in trouble and to supply the power from some other source; secondly, by the use of steam generating stations which, though more expensive than the hydro plants, are indispensable for use when the hydro fails as well as for helping out during time of peak load.

The high quality of electric service maintained in California today is due in no small measure to the inter-connected system in operation from end to end of the State, and it is exactly this sort of a system which the eastern power companies are aiming at when they speak of "superpower." As to this word "superpower," it would seem to fall far short of expressing that for which it now stands. For it is not a "super" power scheme that is projected on the Eastern coast, but merely the intelligent use of our natural resources, including water, coal and oil, to the end that electric power may be economically *produced and delivered* at the points where its use will prove of the greatest benefit to all.

In closing, it should be stated that this article does not aim to touch on all the various problems arising in connection with the transmission and distribution of electric energy; rather its aim has been to aid those not familiar with the methods used in gaining some concrete idea of the general features involved. We have referred to our friend, Mr. Average Citizen, and his reading lamp. If, Mr. Citizen, the next time you consider "power" as related to this lamp, your mind is not wholly filled with pictures of dams, and lakes, and tunnels, but stops for a moment to consider transmission lines, condensers, regulators and the like, then our purpose will have been accomplished.

In the Path of State Development

The East Bay industrial district, which in the past two years has grown faster than any similar district in the State, reports the location of three new large industries. These are the Pacific Concrete Company, who will manufacture a concrete face brick and mantles; the Schumaker Wall Board Company and the R. B. Ward Baking Company.

The Schumaker Company has stared its plant, which will cover five acres of ground, and will manufacture all types of wall board material.

R. B. Ward & Company have long been one of the largest wholesale baking companies of Los Angeles, and are to erect a large bakery on their own property to supply both the wholesale and retail trade.

The Peerless Light Company of Chicago has just announced the opening of its California branch in Oakland. This company started manufacturing gas mantels and lighting fixtures in 1892, but of late years has specialized in electric fixtures.

"Pacific Service" is spending approximately $12,000 in the Sonora district to by-pass Phoenix Lake and insure the towns of Sonora and Jamestown an uncontaminated water supply. The by-pass consists of a 1900 foot stretch of 24-inch pipe and 650 feet of new ditch.

The first carload of pears shipped out of Yuba county this season brought $2,460 in Chicago, according to the United Fruit Distributors, Sacramento.

The car, containing fruit from R. W. Schmidt and Bonanza ranches, left here June 23.

Actual shipping in carload lots of Bartlett pears from the trees of the New England orchards started to eastern markets the latter part of June. These pears have won renown for the past twenty years for their high flavors and their fancy packing and have brought the highest prices of any pear pack in the nation in the eastern fruit exchange.

As soon as the peak of the season is reached there will be beeween four and five hundred people employed in the New England orchard in picking and packing the big crop.

A total of 2,180 acres of new orchands were planted in Yuba county during the past spring, according to the report of Horticultural Commissioner Gordon Laing, filed with the Supervisors. The report shows 40 acres of new vineyards to have been planted during the spring.

April practically closed the planting season, and it is interesting note in Commissioner Laing's report that a total of 280,365 trees and vines were individually inspected by his office during the season from January to the end of April. The numbers of acres of the various fruit plantings were as follows: Apricots, 15.6; Cherries, 13.4; citrus, 1.4; figs, 138; olives, 12.6; peaches, 1,169; pears, 102.6; persimmons, 15.6; prunes, 466.9; walnuts, 167.5; grapes, 50; miscellaneous, 77.5.

A rapid development of the rich lands of Yuba county is taking place as is shown by the new acreages planted. It will not be long before every resident of this section will experience the increased prosperity that must naturally follow such development work. In this connection it is the hope and aim of the Horticultural Commissioner to furnish adequate protection to the agricultural interests of this county, thereby fostering the prosperity and welfare of every taxpayer.

The Pacific Gas & Electric Company is soon to launch service on a new irrigation project to develop a 4800 acre ranch in San Joaquin Division for the Burkhart Investment Company of Los Angeles. The proposed system will pump from the San Joaquin river to the uplands through a main highline ditch approximately four miles long, while the extensive river bottom lands will be flooded by means of an intermidiate lateral. The entire installation calls for eleven new vertical type turbine pumps with a total connection load of 335 horsepower. The project will receive "Pacific Service" from the 11,000 volt distribution line running out of the company's Vernalis substation.

The river pumping plant will house

pumping capacity to the extent of 20,000 gallons per minute putting a total load of 100 horsepower on the motors. Between this point and the end of the main canal are five main lifts with an average head of 13 feet. Two of the five plants will each have two 4500 gallons per minute, 25 horsepower pumps while the remaining three plants will will each house one 30 horsepower 4500 gallon per minute installation. Seven of the pumps on secondary life will be identical as to horsepower and capacity to provide for interchange from one plant to another in case of emergency.

The economic importance of such development cannot be over emphasized. It has always been a "feast or famine" with the "West Siders" since the earliest days when the fertile Coast Range slopes were only cattle ranges. Fickle rain clouds have a tendency to sail high over this region and shower their abundance farther inland. Irrigation enters as an economic stablizer to free the farmer from the vagaries of storm and drought.

Plans are under way for the erection of eight new dehydrator plants this summer in Sutter county. Of these four are now under contract, and the contracts will be let on the remaining four within the next three weeks.

The first of these eight new fruit-drying plants will be erected at Meridian, where a wonderful development in the planting of fruits has taken place during the past few years.

These plants are to be erected under the patents of one of the best known dehydrating systems in the State and furnished emphatic evidence that there are men with capital who have confidence in the fruit producing possibilities of Sutter county this year, despite the greatly exaggerated effect of the frost.

Word comes from San Jose that the San Jose Water Company is rushing work on its new ten-inch high-pressure water main from the Cambrian reservoir to Los Gatos, a distance of approximately five miles. This water will be pumped from the Cambrian reservoir to the Tisdale reservoir above Los Gatos, which will insure a water supply for the city of Los Gatos and the surrounding country. The work calls for an installation of 200 horsepower in electric energy.

The Beechnut Company's new plant in San Jose is now operating and is using gas for water heating and for confectionery furnaces. Each furnace will take care of, approximately, three batches per hour, using about 170 cubic feet of gas per batch. When the confectionery furnace was first installed, an ordinary ring burner was used. This did not give the required speed per batch, nor the right consumption in gas. In each case it was just about double what is now being obtained. A blower system is being used on one of the furnaces and will be installed in the others later on. This company contemplates using three or four furnaces.

Many new "Pacific Service" installations are noted in San Francisco. A new 1500 KW rotary was recently installed at Station "B." This additional equipment will insure ample capacity for the DC load during the coming winter in the business section served by that station. Three new 9000 ampere rotaries will soon be ready for operation at Station "C." These machines will also be used for handling the heavy load in the downtown section during the winter months. At Station "H" two 100-KW oil circuit breakers are being put on the terminus of Standard lines coming up the peninsula and these will greatly safeguard the service to and from the transmission system. The new 7500-KW bank of transformers recently installed at Station "I" is ready for operation and provides ample current for that rapidly growing section of the city.

The work of dismantling the two-million cubic foot holder at North Beach plant is now under way. This is in preparation for a new three-million holder to be erected on the same foundation as soon as the old one is removed.

It is reported that the old Rising Sun property near Colfax has been taken over by the California Premier Mines Corporation, and development work on an extensive scale will be resumed at once. The new company has also taken over the Big Oak Tree Mine adjacent to the Rising Sun, and the two properties will be consolidated.

Plans call for further sinking in the shafts of both the Big Oak and the Rising Sun and, also, a drain tunnel to be driven

from Bear river to unwater the workings of the Rising Sun.

Both mines have been good producers in past years, and the management reports large bodies of good ore readily accessible. Electric energy to the extent of nearly 300 horsepower will be utilized by the new company.

A recent extension line has been completed that serves the Ione Fire Brick Company in San Joaquin Division with additional load of 150 horsepower in motors. The company is so well sold on electrical equipment that it proposes to utilize part of this load in recharging the batteries of its electrically driven yard cars. It is interesting to note in this connection that this additional revenue comes from the former territory of the Amador Light & Power Company which was taken over by the Pacific Gas and Electric Company the first of the year.

Another instance of additional load from an acquired property is furnished by the Woods Irrigation District located on Roberts Island, ten miles south west of Stockton. "Pacific Service" has furnished this district an additional pump unit of 75 horsepower to be utilized in bringing more ground under irrigation. Formerly the Oro Electric Company was located on the lines of the district.

Indications are that there will be a good orange crop in the Oroville district this season, as the June crop is reported to be moderate, according to County Horicultural Commissioner Earle Mills.

The fruit is apparently setting well on the trees and present indications are that it will be of larger size than last year.

The successful venture of a Wheatland rancher last year in raising watermelons on a commercial scale has resulted in the planting of much greater acreage in Yuba county this year, and it is conservatively estimated that 125 cars of watermelons will be shipped to Pacific coast points from Yuba county during the next two months.

These local melons are now on the market, fully two weeks ahead of the Turlock melons.

This year's acreage in Yuba county is divided between plantings on the Bear river near Wheatland and others in the Yuba river bottoms near the city of Marysville.

Orders involving expenditures amounting to approximately $10,648 for additions to the Placer and Nevada county properties of the Pacific Gas and Electric Company were released recently. Improvements will be made at the Auburn Water Works, involving the installing of 1850 feet of four-inch main on Brook road and Borland street. In the Nevada district, approximately 4900 feet of power line is to be installed to serve additional applicants with electric energy for agricultural and domestic purposes. Approximately 3200 feet of power line will be built west of Applegate. In the vicinity of Roseville lines are to be built to serve the Enwood Sand and Rock Company with 150 horsepower in electric energy.

The logging season is now on at the camps of the Standard Lumber Company, Tuolumne county, and many carloads of logs are being daily dumped into the mill pond at Standard. The big lumber mill was put in night operation about two weeks ago, and will be kept humming day and night throughout the season. A record-breaking cut is anticipated this year.

Plans are on foot for the erection of an immense cutting department. The new building will be some 200 feet square and will be equipped with everything of the most modern. Foundation work is well under way on the new hospital of the company. The building will be of Mission style, terra cotta stucco finish. Equipment and arrangement will be ultra modern and the new hospital will be one of the best, if not the best company hospital in the State.

An evaporated milk plant costing $100,000 is to be erected at Ripon, San Joaquin county, as soon as plans can be completed, according to an agreement between the Ripon Chamber of Commerce and the Meyenberg Evaporated Milk Company of San Francisco and Salinas. The plant will be completed about August 15 and will have a capacity of 100,000 pounds of raw milk daily, which will be converted into the well known brand of M. & M. evaporated milk. The building will be 65 feet wide and 100 feet long, and will furnish employment for a number of workmen, as

it will be run the year round. The milk company was offered many attractive sites throughout the dairy sections up and down the valley, and after a thorough survey of all of the locations Ripon was selected as the center of the diary section having the greatest opportunties.

The apples shipped to London, England, last season by the Tuolumne County Apple Growers' Association netted the growers a larger profit than they could have made by selling the fruit in this country. This season a larger shipment is contemplated with a proportionate increase in profits, as the freight rates will be better for a larger shipment. The Tuolumne county brand known as the Bret Harte, is enjoying an immense popularity, due not only to the well known name of the illustrious author which it bears, but, also, to the fine quality of the fruit itself.

What is said by agriculturists to be a phenomenal yield for two-year old Thompson seedless grape vines is promised by a 40-acre vineyard east of Lomo, in Sutter county, owned by Roy Van Tiger. Van Tiger expects to harvest 340 tons of grapes from the vineyard, an average of eight and one-half tons an acre.

A mature vineyard that produces at the same rate is a good one, and a vineyard does not reach maturity until it is five or six years old. Van Tiger's grapes are formed in excellent clusters, and it is believed they will make fine shipping stock.

About 90 tons of cherries were consigned from Yuba City to the East in the 1924 cherry-shipping season, which ended in Sutter county last month. The amount of cherries is said to represent but 20 per cent of a normal crop of 350 tons.

The Sheep Ranch mining district of Calveras county gives promise of being one of the State's leading gold producing camps, as well as having the richest known deposit of cobalt and arsenic. Last year there was but one mine, the Golden Eagle, in operation in this district. Six mines are now under development and it is believed quite a number more will be in operation before fall.

All this activity but confirms the opinion of the representatives of the Department of Mines and of the Sacramento Chamber of Commerce who recently visited the mines of Tuolumne and Calaveras counties. They stated that Tuolumne and Calaveras will ultimately be the two greatest mining counties in the State. It is our earnest hope that they may be correct.

A pocket which promises to compare favorably with those of the famous Bonanza mine was struck in the Fox mine near Sawmill Flat, Tuolumne county, recently. Chunks of gold quartz weighing 16 pounds were taken out the first day, and more in lesser but still large quantities has been taken out every day since, and the deposit still continues. A conservative estimate of the amount taken out places it at 40 pounds.

A raise in which the pocket was found was made by former pocket hunters who had gone past its location after missing it by a few inches and given up the search. The present prospectors, Dondero and Bloom, were also about to give up when they came upon this valuable pocket. The mine has been worked off and on since the earliest days of mining and has yielded many pockets, large and small in size, to different prospectors. One about 40 years ago is said to have held $75,000 worth of gold.

While the State as a whole shows a reduction in building permits for April of 17 per cent, the East Bay Section shows an increase, with the outlook for a larger increase in the next two months.

Los Angeles, where the average building permit calls for a cost of $2,470, showed a reduction of 23 per cent as against an increase of 10 per cent in the East Bay area, where the average cost is $3,466.

The above figures were released by S. W. Strauss & Company, who gave further figures just revealed by a survey of business and building conditions. Business during the month of May, nothwithstanding the dry year and the hoof and mouth epidemic, was nearer to normal in Oakland than in any other city on the Pacific Coast.

In all this remarkable growth "Pacific Service" is participating and is keeping step with by constant additions and improvements of service facilities in every section of its territory.

Eighth Annual Dinner of the P. S. E. A. Draws Record Attendance

Breaking all former records of attendance, upwards of 2,600 members of the Pacific Service Employees' Association assembled in the Civic Auditorium, San Francisco, on the evening of Saturday, June 14, for the eighth annual dinner of the association.

Representatives were present from every one of the twelve territorial divisions comprising the "Pacific Service" territory. They came from far-away Shasta on the north, from as far south as Fresno and to the eastward from the very summit of the Sierra Nevadas. Men and women employees alike have come to look forward to this annual outpouring that in its spontaneous enthusiasm is so typical of the institution we love to call "Pacific Service." At their own expense, they undertook the journey to the western metropolis and thought the few hours of social gathering, of feasting, of vaudeville, of dancing, all worth the while. It was a gay assemblage that President Creed looked upon from the seat of honor at the speakers' table on the right hand of the president of the association, Mr. Ralph DuVal.

It happened to be Flag Day in the United States, and so flags were the principal order of decoration. The red, white and blue was conspicuous in hung banner and in streamers. From the "Pacific Service" emblem, in the form of a bell, which was hoisted near to the dome in the center of the great hall, three-inch streamers of paper, 250 in all, were strung to the balconies. There was no break in the continuity of this color scheme, for a false balcony had been erected in front of the great organ so as to make the entire composition symmetrical. Behind the head table three American flags were draped from the organ loft, while all around the balconies hung Japanese lanterns electric lighted.

One spectacular effect deserving of special mention was produced by the members of West Side section upon roll-call. It consisted of a huge revolving globe, the entire surface of which was studded with countless small mirrors. This occupied the center of the floor, and as the globe revolved three spotlights were thrown upon it from the galleries. The effect was weird as well as striking and the idea had enough of the original to attract more than ordinary attention.

A stage of sufficient height to be seen from all parts of the hall was placed in the center and from this various vaudeville features were given during the dinner, so that there was afforded that agreeable pause between courses, which, as every medical man tells us, is conducive to good digestion. The menu was as appetizing as the culinary art could make it. Just a year ago, at a similar gathering held in Oakland, the then chairman announced that the association had purchased its own dishes and silverware for use upon such occasions. These came into good service this year, and it is worthy of note that no less than 250 employees volunteered their services as waiters and kitchen boys, in any capacity, in fact, that would insure the best up-to-date service for the assembled guests. Two thousand pounds of sugar-cured ham, six thousand rolls, six sacks of lima beans, fourteen sacks of selected potatoes, two barrels of olives, one barrel of pickles, 4,400 individual ice cream bricks, 12,000 cookies, and 3,000 lollipops were used. To make up the salad served, 250 pounds of fresh picked shrimps, which took ten people two days to prepare, and twenty-four sacks of vegetables of six different kinds were used. About thirty thousand pieces of tableware were used in serving the dinner.

Besides President Creed there were seated at the head table First Vice-President and General Manager F. A. Leach, Jr., Second Vice-President and Treasurer A. F. Hockenbeamer, Third Vice-President and Secretary D. H. Foote, Assistant Secretary Charles L. Barrett, and Director Norman B. Livermore. A special guest of the occasion was Mr. Preston S. Millar of New

York, Secretary of the Association of Edison Illuminating Companies. When the feasting was over Chairman DuVal made a brief address of welcome to the assemblage. He congratulated the association upon an unusually happy reunion and he paid tribute to the members of the San Francisco section for the help they had rendered in arranging the feast and attending to the one hundred and one details which are incidental to such occasions. Speaking of the association in itself, Mr. DuVal said:

"Its growth, in the short period of eight years, in strength and influence must, indeed, be satisfying to those who have devoted their time and energy to its purpose. Its history is one of substantial achievement and the necessity for its existence has long since ceased to be a matter of debate. What is left now is to measure up to the responsibility that comes with advancing years and to make sure that increasing power is turned to fruitful ends. Undoubtedly the association is destined to speak, if indeed it does not already do so. as the accredited voice of the employees of 'Pacific Service.' As the Sacramento gathers in its course by stream and brook and river the waters of this northern portion of California so this association, let us hope, will gather in one great current of helpful service the energies of its entire membership."

The only other speaker was President Creed, who supplemented what the association chairman had said by a hearty message of congratulation to the men and women of "Pacific Service" upon the wonderful growth in scope and achievement of this association of employees that in its working organization recognizes no differences of rank in the company's service but, outside of its affiliation with the parent company, is an independent organization of men and women working for their own uplift socially, educationally, and in every other worthwhile way, all united in the common cause of "Pacific Service." The association numbers now nearly 7,000 souls and President Creed spoke with deep feeling of this wonderful showing. He touched upon matters of employees' welfare and he instanced the association's recent achievement in that direction, namely, the disability plan, that is now in full working order and from whose fund several thousand dollars have already been paid out to sick and disabled employees of "Pacific Service" who have secured this benefit through their membership in the association. President Creed pledged the hearty co-operation of the company's management in the association's welfare activities. In conclusion Mr. Creed referred to the unusual climatic conditions that have come upon the fair land of California. It was not possible, he said, to close the eye to the fact that a shortage of water menaced the power companies of the state, but he assured his hearers that, so far as the company he and those before him represented was concerned, every endeavor would be made to accommodate electric consumers throughout the balance of the year without change in rates or reductions of service.

Needless to say, the speakers were loudly applauded. Dancing closed a most successful evening.

The dinner committee was headed by Mr. Van E. Britton of East Bay Division. Assisting him in various capacities were Messrs. W. R. Baker, W. M. Henderson, J. M. Williams, W. N. Munro, J. A. Johnson, A. U. Brandt, W. D. Skinner, Frank Talcott, J. Charles Jordan, Ed. O'Mahoney, J. S. Worthington, Elmer Campbell, and R. P. Lutzi. The present working organization of the Pacific Service Employees' Association consists of the following:

R. W. DuVal, Chairman; W. D. Skinner, Vice-Chairman; Miss B. J. Dale, Secretary; J. C. Carmody, Executive Secretary and Treasurer; H. T. Terry, Auditor; Executive Committee—R. R. Cowles, H. W. Beekman, T. B. Copeland, J. A. Johnson, W. N. Munro, W. R. Baker, Van E. Britton, H. J. Smith, J. S. Worthington. There are fifteen standing committees, Policy, Sectional Activities, Finance, Educational, Benefit and Loan, Social Activities, Publications, Membership, Publicity, Recreational Activities, Women's Affairs, Reception, Editorial, Property, Athletic.

In addition, the association is represented on the Employees' Welfare Committee of the company by three delegates elected from various sections of the "Pacific Service" territory.

PACIFIC GAS & ELECTRIC COMPANY

A California Corporation

Managed by Californians Operated by Californians

"PACIFIC SERVICE" REPRESENTS (AS OF DEC. 31, 1923):

9,993	employed in all departments.
$219,000,000	capital invested in gas, electricity, railroads, steam, water and telephone plants.
59,000	square miles of territory in which it operates—an area greater than that of England and Wales.
27,013	stockholders, December 31, 1923.
38	counties of the State in which it transacts business.
710,034	consumers served with gas, electricity, water and steam as of Dec. 31, 1923.
2,158,000	people served in 38 counties, which is over 50% of the State population.
290	cities and towns in which it supplies service directly and through other companies.
$15,837,808	annual wages paid employes in 1923.
$2,968,213	taxes, State of California, for 1923.
$1,061,674	taxes, Federal Government, for 1923.
415,348	horsepower developed in 26 electric water-power plants.
173,592	horsepower developed in 4 electric steam plants.
588,940	total horsepower developed in 30 plants.
1,198,463,727	kw. hrs. sold in 1923. This is equivalent to the effort of 3,990,000 men.
13,674,794,300	cubic feet of gas sold in 1923.
18	gas plants.
54,400	miles of wire used in distributing electricity. This is wire enough to be strung around the world over 2 times.
3,608	miles of mains used in distributing gas. Greater than the distance between San Francisco and Key West, Florida.
1,100	miles of mains and ditches used in distributing water.
1,100	miles of track of street railway supplied with electric power.
65,374,091,546	gallons of water stored in 109 lakes and reservoirs. This amount of water would supply the City of San Francisco at the present rate of consumption for nearly 5 years.
94,650	acres of land owned in California.
232	parcels of property owned in cities and towns.
4,482,030	barrels of California Oil used in 1923.
160,713	horsepower in agricultural motors depending on "Pacific Service."
512,304	horsepower in mining, electric railways, manufacturing and other motors depending on "Pacific Service."
50,800	street lamps, gas and electric, lighted by "Pacific Service."
6,261,119	incandescent lamps nightly lighted.
1,231,201	horsepower connected to system.

PACIFIC GAS AND ELECTRIC COMPANY

Head Office: 445 Sutter Street

San Francisco

Branches in all principal cities and towns of 38 counties of North Central California.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 728,000 CONSUMERS OF

GAS ı ELECTRICITY ı WATER

2,157,957 Total Population Served in Thirty-eight of California's Counties

CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL	
	No.	Population	No.	Population	No.	Population
Electricity	243	1,543,459	45	196,370	288	1,739,829
Gas	66	1,457,631	2	11,431	68	1,469,062
Water (Domestic)	24	87,300	5	14,100	29	101,400
Railway	1	83,000			1	83,000

Place	Population
[1]Alameda	31,000
[2]Albany	3,700
Alamo	100
Alta	100
Alvarado	1,100
Alviso	600
Amador City	750
Anderson	900
Angels	941
Angel Island	500
Antioch	2,600
Applegate	100
[6]Aptos	300
Arbuckle	900
Asti	100
[2]Atherton	600
[5-6]Auburn	2,500
Banta	50
[2]Barber	500
[2]Belmont	900
Belvedere	700
Benicia	2,750
[6]Ben Lomond	500
[2]Berkeley	70,000
Bethany	50
[6]Biggs	725
Big Oak Flat	750
Bolinas	300
Boyes Springs	750
Brentwood	400
[2]Broderick	700
Browns Valley	125
[2]Burlingame	8,000
Butte City	300
Byron	350
Calistoga	1,000
[2]Campbell	1,300
Camp Meeker	300
[2]Capitola	350
[6]Carmel	1,800
Cement	1,000
Centerville	1,750
Ceres	1,000
[2]Chico	11,000
Cloverdale	800
[5]Colfax	600
College City	250
Collinsville	300
[2]Colma	2,750
[5-6]Columbia	250
[2]Colusa	2,000
Concord	1,000
Copperopolis	300
Cordelia	350
Corning	1,800
[2]Corte Madera	800
[2]Cotati	400
Cottonwood	450
Coyote	200
Crockett	2,000
Crow's Landing	300
[2]Daly City	5,000
Danville	420
Davenport	500
[2]Davis	1,700
Dayton	60
Decoto	500
[6]Del Monte	300
Denair	400
[5]Dixon	1,000
Dobbins	100
Drytown	200
Duncan's Mills	250
Durham	400
[5-6]Dutch Flat	400
Dunnigan	300
Eldridge	500
[2-6]El Cerrito	1,600
Elmira	300
El Verano	400
[2]Emeryville	5,000
Escalon	700
Esparto	500
[2]Fairfax	600
Fairfield	1,050
Fair Oaks	400
Fall River Mills	250
Farmington	300
[6]Felton	300
Finley	100
Folsom	2,000
Forestville	300
[1]Fresno	79,500
Gerber	250
Geyserville	500
[6]Gilroy	3,500
Glen Ellen	1,200
[6]Gonzales	500
Graton	150
[3-8]Grass Valley	5,000
[6]Gridley	2,500
Grimes	500
[6]Groveland	400
Guerneville	1,000
Hamilton City	300
Hammonton	500
[2]Hayward	4,500
[6]Healdsburg	2,600
[6]Hercules	400
Hickman	40
[2]Hillsborough	950
[6]Hollister	5,000
Honcut	500
Hopland	500
Hughson	600
Ione	850
Irvington	1,000
[5-8]Jackson	1,900
[5-8]Jamestown	1,000
Kelseyville	600
Kennett	400
[2]Kentfield	750
Kenwood	300
Keswick	20
[8]King City	1,100
Knights Ferry	200
Knights Landing	400
La Fayette	250
[6]La Grange	200
Lakeport	1,200
[2]Larkspur	900
Lathrop	300
Lewiston	150
[5-8]Lincoln	1,500
Live Oak	300
[5]Livermore	2,300
[2]Lomita Park	1,250
[5]Loomis	500
Los Altos	800
[2]Los Gatos	3,500
Los Molinos	300
Lylton	100
Madison	300
Manteca	2,000
Mare Island	400
Martell	50
Martinez	4,000
[2]Marysville	8,000
Maxwell	500
[2]Mayfield	1,500
McArthur	125
[2]Menlo Park	3,000
Meridian	250
[2]Millbrae	350
Mills	400
[2]Mill Valley	3,000
Milpitas	350
Mission San Jose	500
Modesto	14,500
Mokelumne Hill	237
[6]Monterey	6 000
Monte Rio	300
[6]Morgan Hill	950
[2]Mountain View	3,200
Mt. Eden	500
[2]Napa	6,800
[3-8]Nevada City	1,800
Newark	1,100
[5]Newcastle	750
Newman	1,500
Niles	1,800
Nord	60
[2-6]Novato	800
Oakdale	2,000
[2]Oakland	265,000
Oakley	200
Occidental	600
Orland	2,000
[3]Oroville	5,500
Pacheco	300
[8]Pacific Grove	3,500
[2-7]Palo Alto	8,181
Paradise	550
Patterson	800
Penn Grove	250
[5]Penryn	250
Perkins	350
[2]Petaluma	7,000
[2]Piedmont	5,000
[8]Pike City	150
[8]Pinole	970
Pittsburg	6,600
Pleasanton	1,100
Port Costa	1,000
Potter Valley	600
Princeton	300
[2]Red Bluff	3,300
[3-8]Redding	3,200
[2]Redwood City	4,500
[2-6]Richmond	35,000
Rio Nida	250
Rio Vista	1,100
Ripon	750
Riverbank	1,200
[6]Rocklin	650
[6]Rodeo	300
[6-8]Roseville	4,500
[2]Ross	800
[4]Sacramento	83,000
Salida	350
[6]Salinas	5,300
San Andreas	250
[2]San Anselmo	4,000
[2]San Bruno	2,000
[2]San Francisco	615,000
[2]San Jose	60,000
[6]San Juan	700
[2]San Leandro	7,500
[2]San Lorenzo	800
[6]San Martin	300
[2]San Mateo	8,500
[8]San Pablo	500
[2]San Quentin	3 000
[2]San Rafael	6,500
[8]Santa Clara	6,000
[8]Santa Cruz	16,000
[2]Santa Rosa	9,500
Saratoga	1,200
[2]Sausalito	3,500
[2]Sebastopol	1,750
Shawmut	300
Shasta	50
Shellville	200
Sheridan	250
Smartsville	300
[6]Soledad	400
[6]Soquel	825
Sonoma	1,000
[6-6]Sonora	3,000
[5]Soulsbyville	200
[2]South San Francisco	5,000
Standard	600
[2-7]Stanford University	3,250
Stanislaus	100
[5-6]Stockton	50,000
Suisun	800
Sunol	250
Sunnyvale	2,200
Sutter City	400
Sutter Creek	1,000
Tehama City	150
[5]Thermalito	250
Tiburon	500
Towle	50
Tracy	3,200
[6]Tres Pinos	350
[5-6]Tuolumne	2,000
Turlock	4,500
Upper Lake	600
[6]Vacaville	1,300
Valley House	200
[2-8]Vallejo	22,750
Vallicito	150
Vina	300
Vineburg	250
Walnut Creek	900
Warm Springs	300
Waterford	350
[6]Watsonville	6,000
[6]Weaverville	500
Wheatland	475
Williams	800
[3]Willows	2,300
Windsor	600
Winters	900
[2]Woodland	5,600
Woodside	300
Wyandotte	250
Yolo	400
[2]Yuba City	3,500

Total Cities and Towns	1,725,754
Add Suburban Population	432,203
Total Population Served	2,157,957

Unmarked—Electricity only.
[1]—Gas only.
[2]—Gas and Electricity.
[3]—Gas, Electricity and Water.
[4]—Gas, Elect. and St. Railways.
[5]—Electricity and Water.
[6]—Electricity supplied through other companies.
[7]—Gas supplied through other companies.
[8]—Water supplied through other companies

"Home is the corner-stone of our civilization"

Warren G. Harding



THE environment of your home is directly affected by the character of the service rendered by the equipment in the home.

Better Gas Appliances make Better Homes.

Permit your local dealer to show you the modern gas range so that you may have properly cooked foods; the automatic water heater, that you may have an abundance of hot water for the sake of cleanliness.

PACIFIC GAS AND ELECTRIC COMPANY

P·G·and E·

"PACIFIC SERVICE"

Gas Is Clean

—with proper burning it produces no smoke, soot, or grease.



209-624

PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO SAN FRANCISCO



ON THE "PACIFIC SERVICE" HIGHWAY BETWEEN DRUM AND ALTA, BEAR RIVER CANYON.

Vol 16 — OCTOBER 1924 — No 2

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER	A. B. C. DOHRMANN	FRANK A. LEACH, JR.
F. B. ANDERSON	JOHN S. DRUM	NORMAN B. LIVERMORE
CHAS. L. BARRETT	F. T. ELSEY	JOHN D. McKEE
W. E. CREED	D. H. FOOTE	JOHN A. McCANDLESS
W. H. CROCKER	A. F. HOCKENBEAMER	C. O. G. MILLER

OFFICERS

W. E. CREED	*President*
FRANK A. LEACH, JR.	*First Vice-President and General Manager*
A. F. HOCKENBEAMER	*Second Vice-President and Treasurer*
D. H. FOOTE	*Third Vice-President and Secretary*
CHAS. L. BARRETT	*Assistant Secretary*
LEROY MOORE	*Assistant Treasurer*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, JR., Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney	LAW DEPARTMENT
C. P. CUTTEN, Attorney	RATE DEPARTMENT
R. J. CANTRELL, Manager	PROPERTY DEPARTMENT
E. W. HODGES, General Auditor	ACCOUNTING DEPARTMENT
H. T. TERRY	CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager	CREDIT AND STOCK SALES DEPARTMENTS
JOHN H. HUNT, Purchasing Agent	PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent	SUPPLY DEPARTMENT
E. G. McCANN, Manager	PERSONNEL DEPARTMENT
	ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT
O. W. PETERSON	Engineer of General Construction
E. H. STEELE	Engineer of Line Construction
F. R. GEORGE	Engineer of Operation
GEO. H. BRAGG	Engineer of Maintenance
	DEPARTMENT OF ENGINEERING
J. P. JOLLYMAN	Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER	Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE	Chief of Division of Civil Engineering
F. M. HARRIS	Chief of Bureau of Specifications and Estimates
O. A. KNOPP	Chief of Bureau of Tests and Inspection
	DEPARTMENT OF EXECUTIVE ENGINEER
F. C. PIATT	Valuation Engineer of Electric Properties
J. T. RYAN	Valuation Engineer of Gas, Water and Railway Properties
W. D. SULTAN	Rate Engineer
S. B. SHAW	Automotive Engineer
W. G. JACK	Manager Land Department
	GAS CONSTRUCTION AND OPERATION DEPARTMENT
FRANK WILLS	Engineer of Production
R. S. FULLER	Engineer of Distribution
HARRY J. SMITH	Engineer of Construction
	PUBLIC RELATIONS AND SALES DEPARTMENT
R. W. ROBINSON	Assistant to Vice-President in Charge of Public Relations and Sales
DON C. RAY	Manager Bureau of Public Relations
N. R. SUTHERLAND	Manager Commercial Department
H. M. CRAWFORD	Sales Manager
H. E SANDOVAL	Manager Electric Sales
FORREST U. NAYLOR	Manager Gas Sales
J. CHARLES JORDAN	Manager Publicity Department

W. B. BOSLEY, General Counsel

JOHN P. COCHLAN, Assistant to the President

F. S. MYRTLE, Editor-in-Chief Pacific Service Magazine

DIVISIONS AND MANAGERS

DIVISION MANAGERS		DISTRICT MANAGERS		HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION			Marysville
I. B. ADAMS	DE SABLA DIVISION			Chico
H. M. COOPER	DRUM DIVISION			Auburn
		L. H. HARTSOCK	Nevada District	Nevada City
L. H. NEWBERT	EAST BAY DIVISION			Oakland
		J. H. PAPE	Berkeley District	Berkeley
H C. ROSS	FRESNO DIVISION			Fresno
H. G. RIDGWAY	NORTH BAY DIVISION			San Rafael
		L. J. PETERSON	Petaluma District	Petaluma
		C. D. CLARK	Napa District	Napa
		C. D. CLARK	Vallejo District	Vallejo
		M. G. HALL	Santa Rosa District	Santa Rosa
E W FLORENCE	SACRAMENTO DIVISION			Sacramento
		C. W. McKILLIP	Sacramento District	Sacramento
		C. E. SEDGWICK	Solano District	Dixon
		J W. COONS	Yolo District	Woodland
HENRY BOSTWICK	SAN FRANCISCO DIVISION			San Francisco
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION			Modesto
		W. E. ESKEW	Electra District	Jackson
		C. R. GILL	Modesto District	Modesto
		J. H. FAGG	Stockton District	Stockton
		CHAS. H. NOACK	Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION			San Jose
		W. T. KELLOGG	Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION			Redding
H. B. HERYFORD	WEST SIDE DIVISION			Red Bluff
		STEPHEN GOIN	Willows District	Willows
		CHAS. HUGHES	Red Bluff District	Red Bluff

Pacific Service Magazine

Volume XVI Number 2

Contents for October, 1924



PIT RIVER HOLDS UP DURING A DRY SEASON - - - - - - *Frontispiece*

HOW "PACIFIC SERVICE" MET A WATER CRISIS
FORESIGHT AND SKILL, CO-OPERATION AND DETERMINATION SAVED A HAZARDOUS SITUATION AND ENABLED OUR COMPANY TO SUPPLY ITS ELECTRIC CONSUMERS ON DEMAND AND WITHOUT INCREASE OF RATES FOR SERVICE - *F. R. George* 35

THE STORY OF ARTIFICIAL LIGHT, THE GREATEST FACTOR OF MODERN CIVILIZATION - - *F. S. Myrtle* 44

"SERVICE" THE WATCHWORD OF THE P. C. G. A. CONVENTION AT SANTA BARBARA - - - - - - - - - - 55

THE FINANCIAL SIDE OF "PACIFIC SERVICE" - - - *A. F. H.* 58

EDITORIAL - 60

A CALIFORNIA CORPORATION - - - - - - - - - - - 63

MAP OF "PACIFIC SERVICE" TERRITORY - - - - - - - - 64



The Pit River has held up during the dry season with practically undiminished stream flow. This view is taken close to the diversion dam at Pit No. 3 power development, which is due for completion next summer. This valuable source of water power supply has been of inestimable value this year in enabling "Pacific Service" to accommodate its electric consumers.

PACIFIC SERVICE MAGAZINE

Volume XVI OCTOBER, 1924 Number 2

How "Pacific Service" Met a Water Crisis

By F. R. GEORGE, Engineer of Operation, Department of Electrical Construction and Operation

Foreword

At the opening of the current month, marking the close of the irrigating season in the agricultural sections of "Pacific Service" territory, the glad announcement was made that, so far as concerned delivery of power to our company's consumers, there was no longer reason to fear any diminution of service. The crisis past, the long period of suspense at an end, the most trying season in the history of power development in California drawn to a close, our company's management was proud to announce that all demands for electricity had been met, including an increased consumption of approximately twelve per cent, and not only, as already stated, had there been no diminution of service but in no instance had there been any increase of rates.

To many good citizens who are but slightly acquainted with the physical and technical details of electric power generation and distribution, this announcement may not convey the picture that presents itself to the mental vision of those who have had to bear the brunt of the burden of heroic effort during this record year of 1924. It was indeed a struggle. For eight seasons in a row California has been below normal in precipitation and the winter of 1923-1924 was the poorest of all in that the season of precipitation reached only forty per cent of normal. Great reservoirs lying amid the mountain peaks of the Sierra Nevada range attained less than fifty per cent of their storage capacity. It was a question not of electric generating machinery and distributing systems, it was a question of water to turn the wheels. The white coal of the Sierras to whose abundance California owes so much of its present day development, had failed of its normal supply.

To the power companies of the State this failure meant much indeed. A power company, like any other public utility, is a public servant and must be ready when the public calls. It may not run short of service, for service is the watchword of the public utility of today. Early in the present year, then, our company's engineers were confronted with the problem of enabling "Pacific Service" to live up to its name. That they met and solved this problem the official announcement before referred to attests. Before the end of January, when it was seen that a drought was inevitable, our company's engineers were spread over the Sierra region measuring depth and density of what snow lay upon the ground, building estimates and arranging for careful handling of the water storage in the clusters of artificial reservoirs from which "Pacific Service" gets its hydro-electric power. How well and skillfully this work was accomplished is told in the subjoined article by the member of our company's engineering staff whose business it is to guide the operations of the "Pacific Service" electric generating and distributing system.

Certainly wonders were accomplished. It being, of course, impossible to operate all our company's hydro-electric plants to anything like full capacity, steam electric plants were called into requisition. Not only were the company's steam stations worked night and day at full blast, but industrial steam plants belonging to other manufacturing concerns were leased and placed in service. Incidentally, a record job was turned out when a new steam electric turbine of 16,750 horsepower capacity was added to the generating equipment at our company's steam station on the river bank at Sacramento, completed and placed in service in less than four and one-half months, or one month ahead of schedule. This feat enabled our company to take care of the pressure of demand in one of the busiest sections of "Pacific Service" territory. Our company's year book for 1924 will show that our electric generating system as of December 31, 1923, included twenty-six water-power plants and four steam-electric plants; before the summer season closed our company was operating forty-two plants in all, the difference in numbers, of course, being represented by steam-electric plants brought into requisition wherever found of service.

It is a great record, one which we feel justified in calling to the attention of our patrons and friends. It is a record established, first, by the foresight and initiative of our company's management, second, by the get-together spirit and skill of our company's employees. Its accomplishment was aided, too, by the spirit of co-operation that rules among the power companies of California. There is, as most of our readers are aware, a system of interconnected electric transmission lines that reaches from the Cascade Mountains in Oregon on the north to the Mexican border at the southern extremity of California, and an eastern arm of which has recently been completed over the Sierra summit into Nevada. These companies are banded together for the common good, and during this year of years they have through their interconnecting system been able to feed one another from time to time with electric power, as the load at one place fell off and at another pressed hard, so that it can safely be asserted that during this year of 1924 not one kilowatt of electric energy generated in the State of California has gone to waste.

On the evening of June 15th last, at the annual dinner of members of our Pacific Service Employees' Association held in the Civic Auditorium in San Francisco, our company's president, Mr. W. E. Creed, in his address to the gathering of twenty-six hundred men and women employees before him, referred to the unusual climatic conditions that had come upon the fair land of California. It was not possible, he said, to close the eyes to the fact that a shortage of water menaced the power companies of the State, but he assured his hearers that, so far as the company, he and those before him represented was concerned, every endeavor would be made to accommodate electric consumers throughout the balance of the year without change in rates or reductions of service.

The endeavor has been made and has been successful.

EDITOR PACIFIC SERVICE MAGAZINE.

Foresight and skill, co-operation and determination, saved a hazardous situation and enabled our company to supply its electric consumers on demand and without increase of rates for service.

Early in the year, when the possibility of a drought stared us in the face, definite plans were instituted in order to assure necessary action being taken in time to be of benefit should the predictions of a dry year be substantiated. It may be of interest to our readers to know in a general way what these plans were and something of their derivation; for undoubtedly it was their careful working out that has to date rendered it possible for our company to carry out its obligations to the consumer.

In the beginning it became quite apparent that the estimated stream flow, together with the contracts for purchased power which were then in effect, would be just about sufficient to meet the load requirements which were then estimated to be about 10 per cent in excess of the previous year, but would not leave a comfortable margin of service to take care of inaccuracies in estimating, etc. In estimating load requirements for a dry season it is proper to take into account an excess pumping load due to conditions which require a greater period of time over which pumping is done; this involves the installation of emergency pumps and extra power required because of the lowering of the water table. With this possibility of increased load in mind, it was decided by the management that we must do something at once to increase our aggregate electric generating capacity. Remember that this decision was made in the middle of the winter season when there might have been a gambling chance that Nature would come to our rescue before the spring; our company's management is not given to standing idly by and shifting the responsibility to the elements.

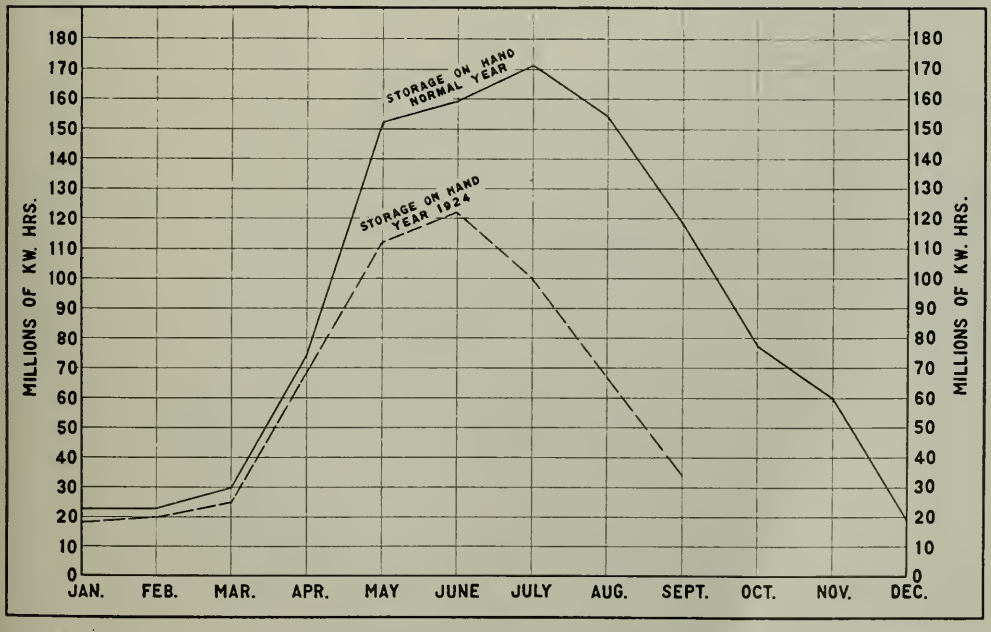


Fig. 1. Comparison of actual storage for calendar year 1924 with normal year, expressed in terms of kilowatt hours per month

Accordingly, in the latter part of January an estimate in the amount of, in round numbers, $1,000,000, was approved for the purchase and installation of a 12,500 K. V. A. steam generating unit to be located at our Sacramento steam plant and to be placed in operation at the very earliest possible moment. It was estimated that this unit might be in service by the first of July. Sacramento was chosen as the location for this equipment because it presented opportunities for making the installation within a short period of time. The original station was designed to house two generating units, and only one had been installed. A slight change in arrangements for the existing equipment, together with increased boiler capacity, stacks, etc., would supply accommodation space for another unit; accordingly the necessary orders were placed and work was started during the first week in February. As a matter of fact, surely a matter of considerable pride to our organization, this installation was made in record-breaking time, for the new unit was placed in service June 15th, four weeks ahead of the original schedule, and has carried full load continuously since the first day of its operation. At the time this article is written, the Sacramento steam plant has generated over 24,000,000 kilowatt hours. If space permitted, we would find in this strenuous building period a fund of experiences and instances of loyal devotion to a cause, extending from the management officers down through the engineering corps to the laborer in the trench. Many of these experiences would furnish stories in themselves.

There are four subdivisions or sources of power supply, namely, water storage, steam power, purchased power, and stream flow. For the purpose of clarity we will consider each of these subdivisions in the order named.

During the late winter months a very intensive snow survey was carried out with a view to ascertaining the water content of

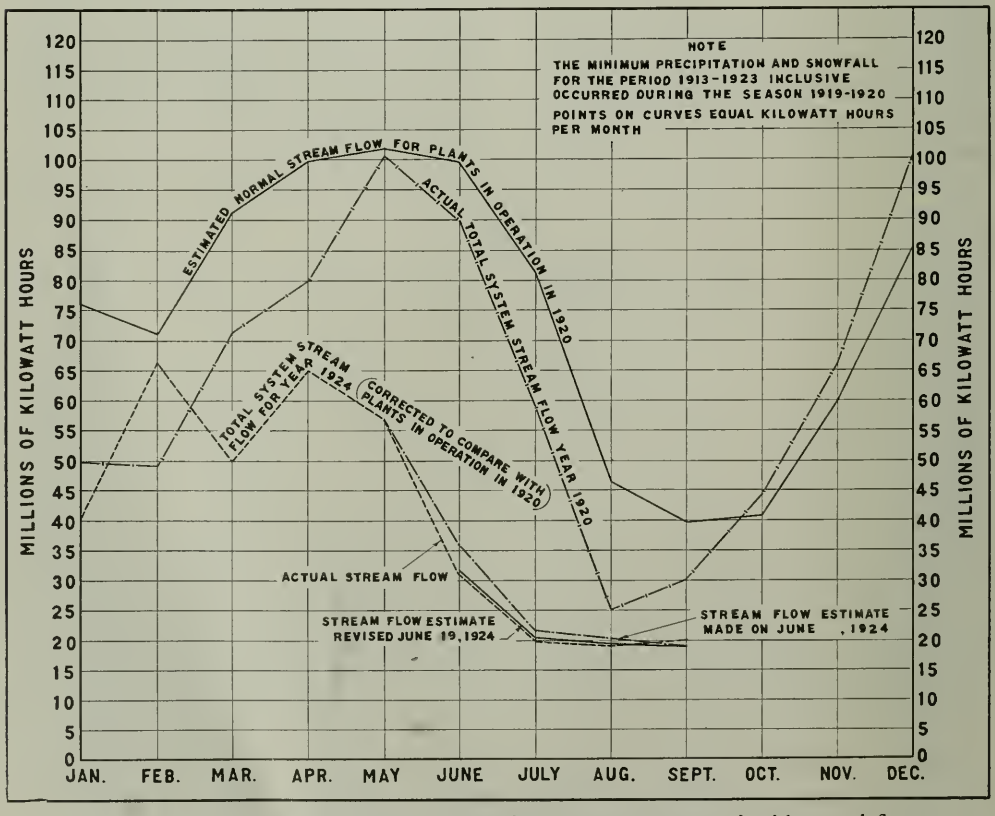


Fig. 2. Estimated and actual stream flow for year 1924 compared with actual flow for 1920 and estimated flow for a normal year

the snow pack, thereby enabling us to estimate the storage we might reasonably expect to result from the snow cover. Such a snow survey consists of a series of careful measurements of the depth and density of the snow at varying elevations taken by means of special apparatus over a definite staked course and taken by the intrepid lake tenders who guard our reservoirs located in the high Sierras during the long winter months.

These snow records were carefully compiled, and as the winter months advanced the survey became more valuable and we were able to estimate to a fair degree of accuracy the spring run-off in the various watersheds upon which our several developments are located. As we approached the spring run-off months, March, April and May, we were able to check our snow survey estimates and begin to measure accurately the water stored in our reservoirs. Due to the peculiarity of the season this storage was practically determined in the month of May and indicated that we would have between 50 and 60 per cent of the water normally stored in our reservoirs. In other words, while we had plenty of storage capacity, Nature had not provided water in sufficient quantities to fill the reservoirs. As a matter of fact, out of thirty-five storage reservoirs in the system only two filled to capacity. It will be readily understood that stored water is a measureable quantity, the accuracy of the measurement of power equivalent being ruled by climatic conditions which affect evaporation.

Figure 1 shows a composite curve of the reservoir contents expressed in kilowatt hours per month for the year 1924 as compared with a normal season. The most critical situation with reference to stored water was expected to occur on the South Yuba system, where it was necessary to strike a very fine balance between the water required for irrigation purposes and that which should be released for the generation of power. In all the calculations for the draft on stored water the paramount necessity is that of guaranteeing that there shall be a sufficient supply of water at all times for domestic consumption. Concerning the South Yuba system, it would have been much easier for the welfare of the system itself as such, to have restricted the use of stored water in the early season and to have been more liberal during the later part of the season. This may seem strange at first sight, but it is easily explained on the basis that such water released from storage

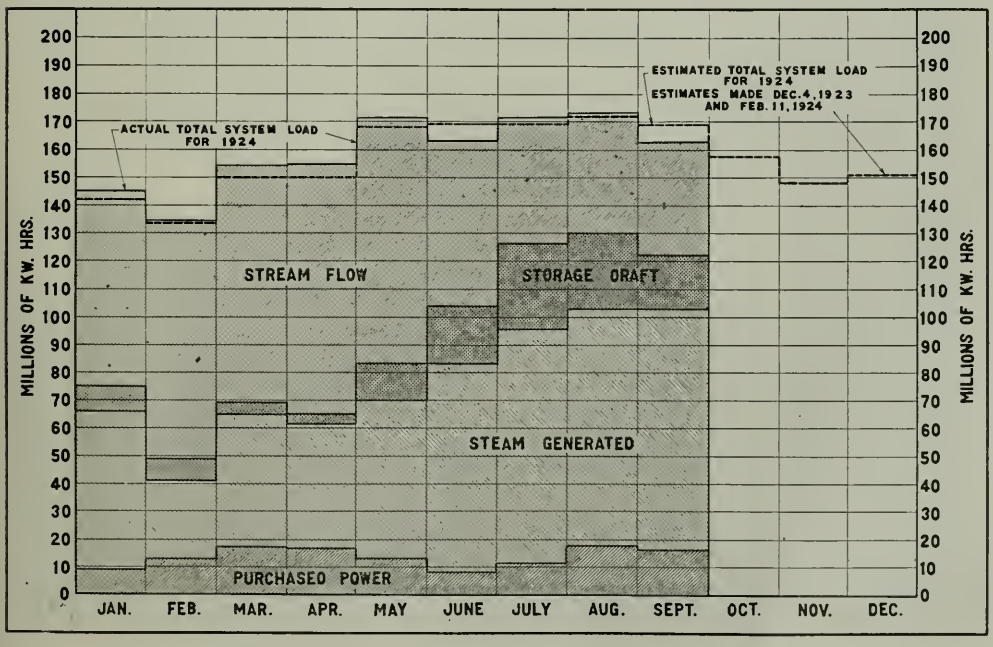


Fig. 3. Estimated system load for year 1924 compared to actual load, with actual amounts obtained from each source of supply

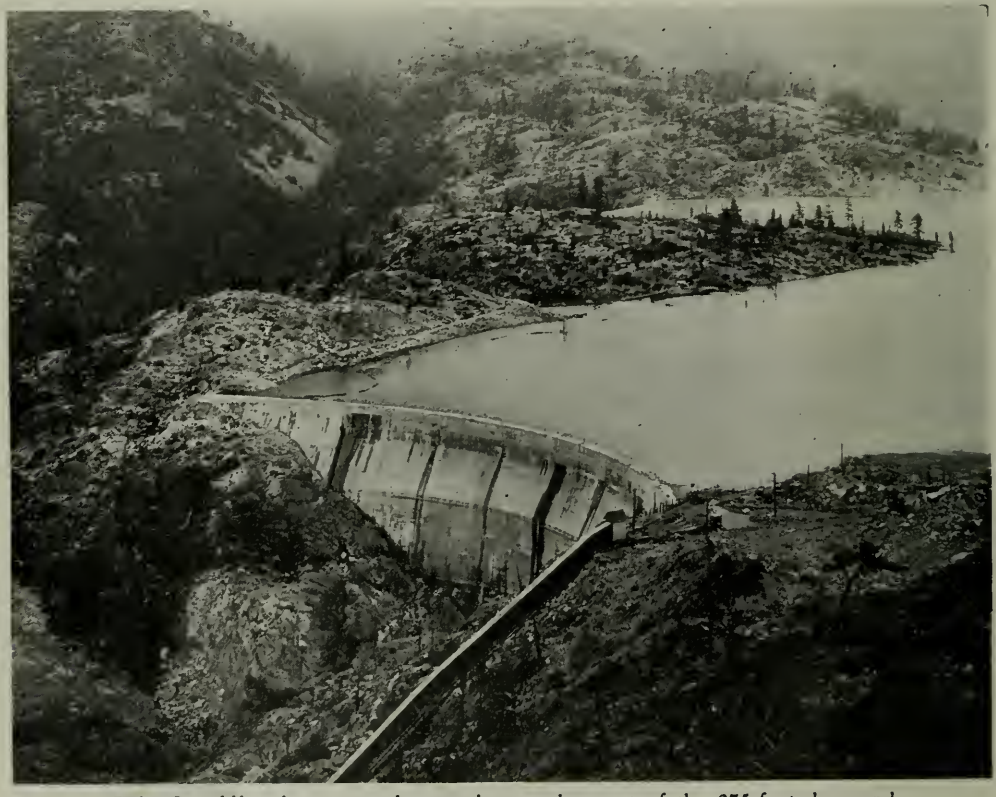
for the purpose of generating power would be of value in the late summer and fall months to compensate for the dropping off in generating capacity of the stream-flow plants. Such an arrangement, however, would not work out well from the fruit growers' standpoint. It is more essential that the growing and ripening fruit be given water in the latter part of the growing season, and if a shortage must be encountered it is better that it should occur after the fruit has been picked; such an arrangement involves less damage all around.

As a matter of fact, through the co-operation of the various agricultural and fruit growers' organizations in this territory a water apportionment program was worked out which resulted in a compromise wherein both interests were served; and so successful was this plan that no policing whatever was necessary. There is a real spirit of co-operation among such organizations when it is a question of combining for the common good.

To a more or less degree similar situations were handled in the several territories supplied by the company with water for irrigation and domestic purposes in addition to the power which is derived from the same source.

The next step was to consider the second source of power supply, steam generation. This, from the mathematical standpoint, was a comparatively simple matter to compute. Allowing a sufficient margin for ordinary maintenance but undertaking to operate at the highest plant factor possible, we were able to set up an estimate of our capacity for generating from steam plants. All we had to have was the plants.

The third item, purchased power, could be estimated on the basis of the contracts which we had with other companies, with certain allowances for their decreased output based on our own estimates of shortage, particularly where such companies were in the same territory and affected by the same



Lake Spaulding in a normal year rises to the crest of the 275-foot dam and is a reservoir of 74,478 acre feet capacity

seasonal conditions that our plants were. Thus we were able to measure the purchased power with a fair degree of accuracy.

This left the fourth and what might be termed the unknown quantity, streamflow, to be considered. An intensive study of each individual water system, supported by our snow surveys and based upon past experience, enabled us to make reasonably close estimates of stream flow. Such estimates did not, of course, take us beyond the period of the present season and were terminated as of October, 1924, which brings us well into the period when we look for the normal fall rains.



High water level reached this year at Lake Spaulding was twenty feet below the level shown in this view of the secondary dam, or 51,142 acre feet

These estimates are illustrated in Figure 2, which shows the original estimate and the revised estimates upon which has been plotted the actual results in comparison with the season 1919-1920, which was then, as far as we are concerned, the driest season of record, together with a curve showing the normal stream flow based on records from 1907 to 1923, inclusive. The curves have been weighted in order to make them comparable with the actual results of the season 1923-1924.

We started off in May on the estimate referred to and for the first two or three weeks remained almost on the line. Then, our estimate not having been sufficiently pessimistic, you will note the stream flow dropped below the minimum of the curve. This was alarming and resulted in a total revision of the estimates and a readjustment of the various sources of supply, not forgetting the necessity of starting up the so-called "jitney" plants. We found opportunity to lease and operate many small iso-



Steam-electric generating station "B," on the bank of the river at Sacramento. A new turbo-generator was installed there this year to meet the demand for electric energy occasioned by the water shortage

lated plants belonging to consumers, and we find ourselves at this writing involved in the operation of over forty-two plants, including our own, in capacities rating from 500 to 96,000 horsepower. As might be expected, the largest plant, namely our Pit No. 1 power-house, gives us decidedly less trouble in every way than the smallest plant we have been operating.

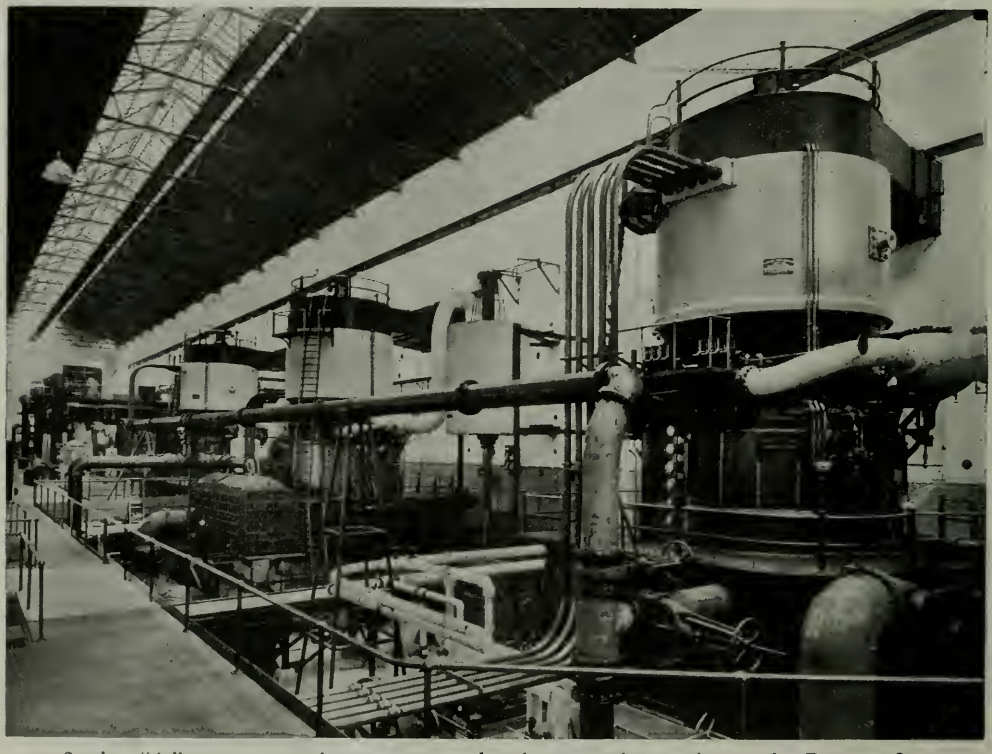
We were thus enabled to see our way clear to carry the load which actual results had shown to be larger than our estimates, due to the fact that the year proved to be more severe than the most pessimistic individuals in the early part of the year had predicted. It should be further considered that owing to our peculiar situation we were involved in absorbing the accumulated shortage of all the generating resale companies with whom we have contracts.

By rigidly following the fixed apportionment of production between these four subdivisions as illustrated in the load curve, Figure 3, we were able to meet from time to time the varying fluctuations in load, together with the fluctuations in the delivery of power to us from the purchased power companies. It may be frankly admitted that all of the quantities had been estimated from a very conservative standpoint and, luckily for us, the factor of safety was sufficient to encompass any short delivery from other companies or unusual accidents to our own generating equipment.

In June another estimate was made and the results of our operations to date were carefully checked. Again the management was assured that we could and would carry our load through the summer without recourse to a reduction.

It should not be assumed that we had unusually good luck, for we had our troubles. For instance, flume trouble occurred at one of our large plants. Far from being dismayed or discouraged, however, the reduced local force was voluntarily augmented by every able-bodied man available, whether lineman or clerk, and a record was established in restoring this heavy flume structure, one of the heaviest in the West, within sixty hours.

Boiler troubles occurred. In one case,



Station "A," our company's great steam-electric generating station at the Potrero, San Francisco; there the aggregate generator installed capacity is 85,781 horsepower

following the failure of a division wall, a boiler was taken out of service, the lining and division wall replaced and connected to the steam line within twenty-two hours. Somebody worked within the boiler when the temperature must have been almost unbearable. Yet the work was accomplished and no ill effects were suffered. It afforded an instance of efficiency and the use of good sound common sense and care, all of which may be considered as a part of the day's work, typifying the earnestness of every man concerned.

Similar instances in other lines could be recounted, such as desperate battling with the unusually prevalent forest fires, floundering around in the marshes fighting high tension line troubles during the very heavy fog conditions, and so on. But such stories would be mere repetitions and would not, I am sure, accord well with the modesty of the type of men who actually do things out on the firing line.

This article, while possibly burdensome in its detail, does not in any way cover all of the intimate and almost heartbreaking occurrences that were met with from day to day. Suffice it to say that we have thus far successfully met all of the drawbacks, accidents, and failures to deliver, together with the abnormal increase in load, without having to ask our consumers to limit their demands in any way whatsoever. And, as we approach the fall of the year, we become more confident that there will be no curtailment of service to consumers.

It is quite obvious that any organization handling a problem as critical as that presented to us during this season could not successfully reach a proper solution unless the fullest co-operation of everyone throughout the organization was obtained. Because we have thus far met the difficulties presented by this problem, it is needless to say that the co-operation of everyone at any and all times was had and the credit, if any be due, should be equally distributed throughout the entire organization.

Foresight of the management in developing a system which could withstand this shock, the courage that prompted the expenditure of hundreds of thousands of dollars in the Sacramento steam plant in advance of the normal requirements of that particular territory, together with the whole-hearted support of the entire personnel of the company, have enabled us to sustain our slogan, "Pacific Service—Courteous and Continuous," even during a year of abnormal drought when Nature apparently sought to handicap our operations.

(As the foregoing article goes to press word comes from the mountain regions that the long drought is broken and that snow has fallen on the peaks of the Sierra Nevada. It is earnestly hoped that this early fall may be taken as a sign that Dame Nature has relented and by her munificent bounty during the winter season at hand intends to make up for all her parsimony of recent years. If our hopes are realized, the season of 1924 will still be remembered as one having its element of good in that it gave opportunity to men like the men of "Pacific Service" to show what they were made of in time of stress.—Ed.)



Our company's high-tension distributing substation Vaca-Dixon; there the 220,000-volt lines from the Pit come in and the power is stepped down for distribution to bay points

The Story of Artificial Light, the Greatest Factor of Modern Civilization

By FREDERICK S. MYRTLE

From darkness into light, literally as well as figuratively. From the drear monotony of existence in all the bestial stupidity of the savage state, from the hour when the untutored mind first began to puzzle over primitive problems whose gradual working out gave our world what it calls civilization, to the present era of undreamed of luxury made possible by man's inventive genius.

A story of centuries, none can say how many, a drama of evolution whose plot has been slow, gradual in the unfolding, this life history of a universe. Only of recent years has the action quickened, till now it is rushing with unmeasured strides to denouements that none may foretell. Startling situations mark its progress, each one recording some new discovery, some brilliant invention, upsetting well-established theories and accepted dogmas, achieving the apparently impossible at every turn.

The cast of characters in the drama is a lengthy one, and each stands out in its place; but, if there be one among them that may be called pivotal it is the character called *Light*.

Dr. Charles P. Steinmetz, whose untimely death last year robbed the scientific world of one of its greatest minds, wrote: "When Prometheus stole the luminous spark from the gods and gave it to man, thus making him the master of light and power, his upward climb began, from the animal to the godlike master of nature. Indeed, the conquest of the fire and the mastery of light and heat which it gave was the greatest step in the development of the human race, was the dividing line between animal and man."

Another General Electric star, Dr. M. Luckiesh, in his admirable work on *Artificial Light* observes: "Among the achievements of science and invention the production and application of artificial light ranks high. As an influence upon civilization no single achievement surpasses it."

What was the beginning of artificial light? What impulse or inspiration marked its genesis? We know, of course, that in the beginning man lived as a beast of the field. His day was from sunrise to sunset, and when darkness fell he crept to his place of shelter and lay there till the dawn drew him forth. But, in the course of time, man discovered fire. Much speculation concern-



Lamps of a century or two ago. (Courtesy of Dr. M. Luckiesh and the Century Company.)

ing this discovery has been indulged in by historical authorities. Dr. Luckiesh says: "A study of savage tribes of the present age, combined with a survey of past history, of mythology, of material relics and of the absence of lamps or other lighting utensils, leads to the conclusion that the earliest source of light was the wood fire, made by energetically but skillfully rubbing sticks together."



A group of oil-lamps of two centuries ago. (Courtesy of Dr. M. Luckiesh and the Century Company.)

Geo. A. Hoadley, Past President of the Illuminating Engineering Society, in his monograph on *Illumination* writes: "We do not know how the first fire and light were produced by the cave man. It may have been by carefully observing the burning wood from a tree fired by the lightning. It may have been that he noticed the spark of fire caused when he threw a stone at some night prowler, missed it but struck another stone and from this got the idea of the first flint and tinder. It may have been that he noticed the warmth caused when he rubbed his hands together on a cold day and then developed the original fire stick."



Portable and reflex gas lamps of modern times

Many authorities incline to the flint and tinder theory. H. G. Wells in his *Outline of History* declares his belief in it. "The most probable way in which fire was started was by hacking a bit of iron pyrites with a flint amidst dry dead leaves," he writes, and to substantiate this theory he quotes Ludwig Hopf in *The Human Species* as follows: "Flints and pieces of pyrites are found in close proximity in Palaeolithic settlements near the remains of mammoths." Sir John Lubbock in *Prehistoric Times* and Worthington Smith in *The Primeval Savage* are additional authorities suggesting this origin of fire.

Whatever the correct explanation of the mystery, the fact remains that man discovered fire, and that from fire sprang artificial light whose scientific development has given the world a twenty-four hour day. Fagot, torch, rushlight, brazier, lamp, candle, lantern, were all milestones along the highway of early discovery and inven-

tion. But how slow the progress! The lamps and candles which sprang from such simple beginnings were the only forms of light for illumination for many centuries. True, various substances went into the making, from animal fat to wax and on to oil. True, also, that great ingenuity was exhibited in devising elaborate lighting equipment. Oil lamps are to be seen in the earliest Roman illustrations, and during the height of ancient civilization along the Eastern shores of the Mediterranean Sea lighting of a most elaborate character was effected by means of shallow grease or oil lamps. Beautiful oil lamps of brass, bronze and pewter were in use in Egypt. Lamps to be found in collections of the present day appear to have been made as early as four or five thousand years before the Christian era. But that was as far as the science of artificial lighting progressed.



Outside gas arc lamp

In "the glory that was Greece and the grandeur that was Rome" the arts stood forth in splendid relief. Surely there has been no sculpture of the present day to equal that handed down to us from the old world civilization that existed before the Dark Ages. The architecture of Greece and Rome serves as a model for the designers and builders of today. Nor were the ancient Romans behind in engineering, for they had their up-to-date water systems and aqueducts that were marvels of construction work. Yet they and those that followed them for generation upon generation were handicapped seriously by the shortness of their working day. Mr. George M. Calhoun, Associate Professor of Greek at the University of California, who has delved deeply into the subject, writes:

"When we consider the tremendous progress that the Hellenes had made by the end of the fifth century in science and in art, in fact in every department of human thought, it is rather surprising to find that they were still content to employ almost unchanged the extremely primitive arrangements for lighting, heating, and cooking that had been devised by their ancestors in the remote ages of tribal existence. The wealthiest and most powerful kings of the Homeric Age, in whose palaces, if anywhere, we might expect to find comfort and luxury, seem to have utilized for the three-fold purpose of lighting, heating and cooking the great fire that was kept burning on the hearth in the center of the "megaron," or main hall of the palace. In the fabled palace of Alcinous, king of the Phaeacians, the poet's ideal of barbaric splendor, the great hall was lighted by the blaze of torches held by golden torch-holders in the forms of statues of youths."

By way of contrast, Professor Calhoun finds those same palaces equipped with the most modern conveniences, particularly in regard to water and plumbing, which anticipated our twentieth century achievements. The water systems were particularly elaborate; network of pipes ran under the streets of the city carrying water not only to public buildings and to fountains which served as centers of distribution but to the



Dr. Carl Auer von Welsbach, inventor of the gas mantle

homes of individuals. But, there was no public system of lighting.

So it ran on through the ages. As recently as the beginning of the nineteenth century milady in her sedan-chair was accompanied to and from the play by link-boys carrying blazing torches through the dark and narrow thoroughfares, while her elaborate coiffure had to be accomplished by candle light, and the best that can be said for the otherwise ineffectual means at hand for illuminating the banqueting hall and receiving rooms of her sumptuous residence is that it afforded opportunity for some spectacular effects in the way of ornamental candelabra.

We cannot but commend the marvelous industry of the writers of early days. When we think of the volumes upon volumes they produced, by the slow, grinding process of pen-script, in solemn, dark chambers whose gloom was poorly relieved by oil-lamp or tallow dip, we marvel and still marvel. Far into the night those men must have sat at their lonely desks to leave behind them precious monuments to the learning of their age.

It was not, then, until illuminating gas was discovered and made use of for commercial purposes that relief came and the working day began to expand.



The wizard of electricity—Thomas A. Edison

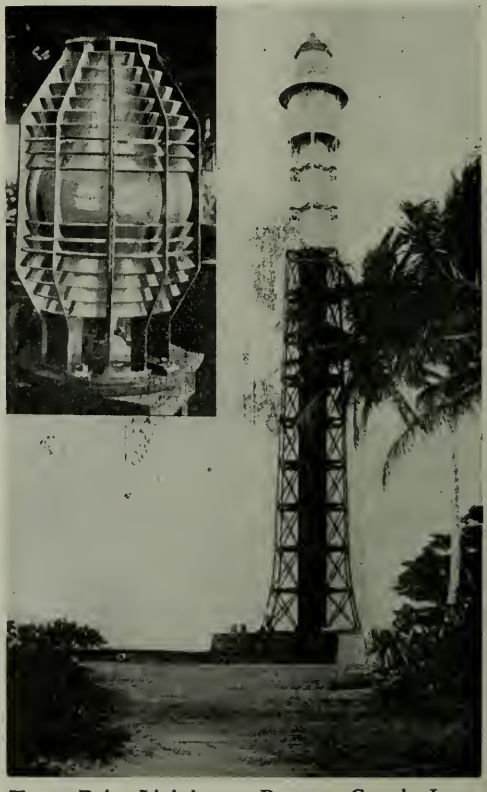
The story of gas reads like a romance. History tells us that natural gas was burned by the Egyptians and early Greeks over 2,000 years ago. It was carried through



A modern shipyard, where the work of construction is carried on successfully under artificial light

pipes or tubing to their temples and used in connection with religious ceremonies. But from that time several centuries elapsed before any further use appears to have been made of this remarkable lighting and heating agent. It was in 1739 that the Reverend Doctor John Clayton, Dean of Kildare in Ireland, made the accidental discovery that what he called the "spirit" of coal was inflammable from its having caught fire by coming in contact with a candle as it was escaping from a fracture in one of his distillatory vessels. He thereupon got some coal and distilled it in a retort in an open fire. To quote his own narrative: "At first there came over only phlegm, afterwards a black oil, and then, likewise, a *spirit* arose which I could noways condense; but it forced my lute and broke my glasses. Once when it had forced my lute, coming closer thereto in order to repair it, I observed that the spirit which issued out caught fire at the flame of the candle and continued burning with violence as it issued out in a stream, which I blew out, and lighted again alternately several times. I then had a mind to try if I could to save any of this spirit; in order to which I took a turbinated receiver, and putting a candle to the pipe of the receiver, whilst the spirit arose, I observed that it catched flame and continued burning at the end of the pipes, though you could not discern what fed the flame. I then blew it out and lighted it again several times, after which I fixed a bladder, squeezed and void of air, to the pipe of the receiver. The oil and phlegm descending into the receiver, but the spirit still ascending, blew up the bladder. I then filled a good many bladders therewith and might have filled an inconceivable number more, for the spirit continued to arise for several hours and filled the bladders almost as fast as a man could have blown them with his mouth; and yet the quantity of coals distilled was inconsiderable."

This discovery led to further experiments, and in 1792 William Murdock, an English engineer, devised a method of making gas in sufficient quantities to be used for illuminating purposes and lighted both his house and garden with it. He was at that time a resident of Cornwall and we are told that he not only made gas there for domestic purposes but he had bladders filled with it to carry at night, "with which and his little steam carriage running on the road he used to astonish the people there." Shortly after that Murdock moved to Birmingham where at the Soho foundry he constructed an apparatus which enabled him to exhibit his plan on a larger scale than any previously attempted. The whole population of Birmingham poured out to gaze at this extraordinary spectacle. That was in 1802. But the way was hard. Not only had Murdock to overcome many difficulties before he could give practical proof of the commercial value of gas, but, when this had been accomplished, he had to convince an obstinate British Parliament that his proposal to light the streets of London was anything better than a beautiful dream. It is said that Sir Walter Scott openly denounced the idea, saying: "There is a madman in London proposing to light London with—what do you think? Smoke!" People could not be brought to see the



Torro Point Lighthouse, Panama Canal. Insert —a completed lighthouse lens. (Courtesy Dr. M. Luckiesh and the Century Company.)

practicability of bringing coal gas through a cold iron pipe and burning it at the end. They thought the pipes would be hot throughout and set the buildings on fire. A report of the inquiry held by a committee of the House of Commons on the first application of the Chartered Gas, Light & Coke Company for an Act of Parliament permitting it to incorporate, in 1809, affords most interesting reading.

Murdock has always been termed the "father of gas lighting." Other scientists, however, joined the pioneer circle, among them Le Bon of France, Becher of Munich and one Winzler or Winsor, a German. In 1803 Winsor publicly exhibited his improved plan of lighting by means of coal gas at the Lyceum Theatre in London. In 1807 he lighted a street in Pall Mall. In 1812 all doubts upon the part of the British authorities were resolved in favor of the new discovery, and the Chartered Gas, Light & Coke Company previously referred to sprang into being. Samuel Clegg was appointed engineer of the company and invented the first gas meter in 1815. He seems to have been a very competent man, for the first cylindrical gas holder was constructed under his direction and another improvement made by him was a device which maintained the pressure of gas approximately constant regardless of the pressure in the holder.

This device, with modern improvements, is in use today and is termed a regulator.

Westminster Bridge was lighted by gas in 1813 and the streets of Westminster during the following year. Gas lighting became popular in London by 1816 and in the course of the next few years it was adopted by the chief cities and towns in the United Kingdom and on the continent. In London in 1917 over 300,000 cubic feet of gas was being manufactured daily. Oil-gas manufacture followed close upon the heels of coal-gas, and in 1822 an Act of Parliament was passed permitting the construction and operation of an oil-gas works in London. In 1806 America saw its first artificial gas in a museum in Baltimore and ten years later that city organized the first commercial gas company in the country. Gas came to California in 1852, when the first company was organized in San Francisco. Twelve years later the Oakland company was organized. There are extant old bills to consumers in San Francisco showing the price charged to have been $15.00 per 1,000 cubic feet.

Gas, however, though useful as an illuminant had to await the Welsbach mantle to achieve its highest point of efficiency in this respect. Dr. Carl Auer von Welsbach discovered that if a web of cotton was soaked in a solution of certain chemicals, then dried and set on fire, an ashy skeleton remained that retained the structure of the cotton and on being heated in a Bunsen flame became incandescent. This was the origin of the Welsbach mantle which raised the lighting value of gas immeasurably.



An up-to-date office equipped with both electric bulbs and gas arc lamps

Then, in due course, came electricity. Once more we are compelled to revert to ancient Greece where, as history tells us, the Greeks first discovered the principle of electricity through the attractive quality of amber to which friction had been applied. Hence the term *electricity*, which is derived from *electron,* the Greek for *amber.*

The various stages along the way of electrical discovery and development are well known to most of our readers and can be passed over briefly. Early experiments were along magnetic lines. The lodestone was known to the Greek philosophers and experimented with by them. Then we take a jump to the twelfth century A. D. when the working of the compass was described by Alexander Neckham, an English monk. About the year 1600 William Gilbert, physician to Queen Elizabeth of England, wrote a book on magnetism and the magnetic pole. In 1650 Otto von Guericke, mayor of the city of Magdeburg, a philosopher, made a machine consisting of a ball of sulphur mounted on a shaft which could be rotated and when the hand was pressed against the globe electricity was generated. He discovered also that electricity could be conducted away from the globe by a chain and would appear at the other end of the chain. In 1709 Francis Hawksbee, an Englishman, made a similar machine, using a hollow glass globe which when exhausted and rotated at high speed and rubbed by hand would produce a glowing light. This was called *electric light* and created great excitement among scientists. Twenty years later Stephen Gray showed the Royal Society that electricity could be conducted about one thousand feet by a hemp thread supported by silk threads. In 1745 the Leyden jar was invented in Germany and Benjamin Franklin, the American statesman, scientist and printer, made numerous experiments with it. In 1791 Luigi Galvani, an Italian scientist, propounded the theory of animal electricity. Allesandro Volta, another Italian, discovered that electricity could be generated by chemical means and made a pile of silver and zinc discs with cloths, wet with salt water, between them. This was the forerunner of the present day dry battery. The term "volt," indicating the unit of electrical pressure, perpetuates the memory of this scientist.



Where flood lighting was used with unusual spectacular effect—The Panama-Pacific International Exposition in San Francisco



Electric "Scintillator" on the Marina, San Francisco, part of the equipment for flood lighting the Panama-Pacific International Exposition

The beginning of electric lighting may be said to date from the beginning of the nineteenth century when Sir Humphry Davy, a well known English chemist, heated strips of various metals to incandescence by passing current through them and showed that platinum would stay incandescent for some time without oxidizing. Using two sticks of charcoal connected by wires to the terminals of a powerful battery of two thousand cells, he demonstrated before the Royal Society the light produced by touching the sticks together and then holding them apart horizontally about three inches. The brilliant flame obtained he called an "arc" because of its arch shape, and thus he drew the first carbon arc. In 1840 Sir William Grove, an English judge and scientist, made an experimental lamp by attaching the ends of a coil of platinum wire to copper wires, the lower parts of which were well varnished for insulation. The platinum wire was covered by a glass tumbler, the open end set in a glass dish partly filled with water. This prevented draughts of air from cooling the incandescent platinum, and the small amount of oxygen of the air in the tumbler reduced the amount of oxidization of the platinum that would otherwise occur. With current supplied by a large number of cells of his battery, he lighted the auditorium of the Royal Institution with these lamps during one of the lectures he gave. The demonstration was only of scientific interest, the cost of current being much too great (estimated at several hundred dollars a kilowatt hour) to make it commercial.

Thomas Wright, an Englishman, was the first to patent an arc lamp. This was in 1845. In the same year J. W. Starr, an American, obtained a patent in England on lamps he had invented. During the years that followed several inventors developed arc lamp mechanisms. In 1876 Paul Jablochkoff, a Russian army officer and engineer, invented the electric candle, which consisted of two rods of carbon placed side by side but separated by insulating material. Several boulevards in Paris were equipped with these lamps.



A vivid example—Niagara Falls

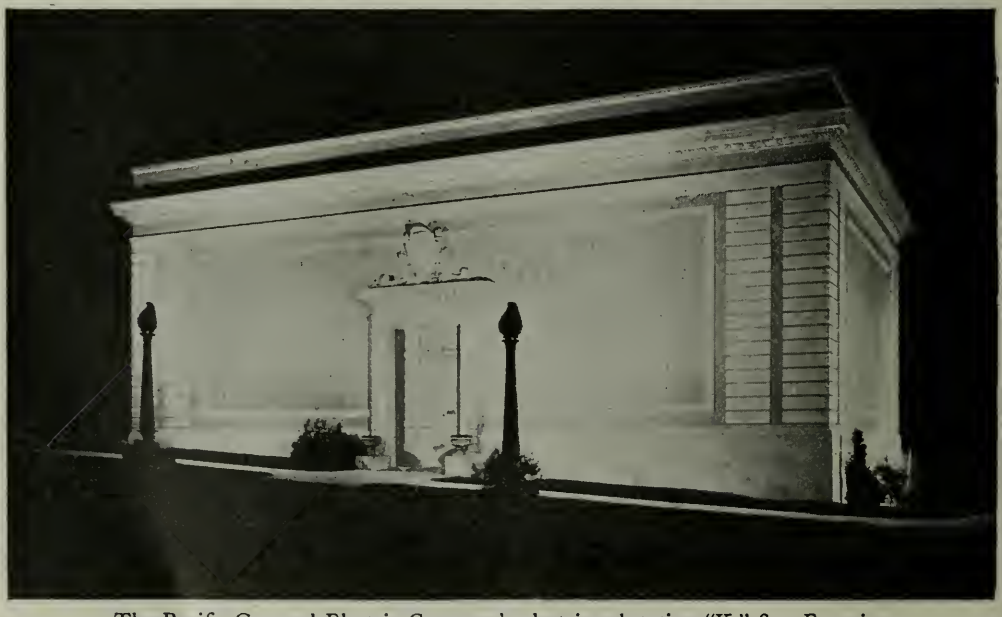
In this country William Wallace, associated with Professor Moses G. Farmer, Charles F. Brush and Edward Weston, invented complete systems of arc lamps and dyna-

mos. In 1878 the Thomson-Houston system was perfected. By this time the arc lamp was commercially established and used for street lighting.

Thomas A. Edison became interested in the electric lighting problem in 1878. He devoted his attention to platinum as a light-giving element, but he found that while platinum had the required high melting point it was too expensive to be used commercially and so recourse was had to a filament of carbon. This was cheap and practically non-fusible, but would be consumed at a much lower temperature than that required for incandescence. This made it necessary to enclose the filament in an exhausted globe or bulb. Thus sprang into being the electric incandescent lamp. The first successful lamp was made in October, 1879, and burned for forty-five hours before it failed. The following month the lamp had been so greatly improved upon that it burned for several hundred hours, and in December a public exhibition of the lamp was given at Menlo Park. The first commercially successful installation of the Edison incandescent lamp and lighting system was made on the *S. S. Columbia* May 2nd, 1880. Experiments to further improve the lamp were continued. It was found that carbonized bamboo made a better filament than carbonized paper, and the shape of the bulb was changed from round to pear shape and a base developed. The first lamp factory in the world was started the same year. Commercial installations were made throughout the Eastern States, so that by the end of 1881 the incandescent lamp was commercially established.

The early lamps gave about sixteen candlepower and lasted about three thousand hours before they burned out. From that time on improvements were made which increased the life and luminous efficiency of the carbon filaments, but it was not until 1905 that any radical improvement was achieved. In that year the Gem series incandescent lamp was put on the market. This had a metallized carbon filament and was twenty-five per cent more efficient than the previous carbon lamp. The highest point of efficiency was reached in 1907 when the tungsten filament lamp appeared. It was four times as efficient as the others and soon displaced them. In 1913 the Mazda C lamp, with its tungsten filament operating in an inert gas, proved to be fifty per cent more efficient than the vacuum lamp, and, at the time of writing the tungsten filament is in evidence everywhere.

The first series incandescent lamp consumed sixty-five watts and gave sixteen candlepower. The smallest lamp now



The Pacific Gas and Electric Company's electric substation "K," San Francisco

regularly made for street lighting purposes consumes forty-five watts and gives sixty candlepower, the largest consumes twelve hundred watts and gives twenty-five candlepower. It gives one hundred and fifty times as much light as the first lamp and is eight times as efficient.

Today, thanks to these wonderful inventions, we are living in a brilliantly lighted world. When one thinks that at the touch of a single button a myriad brilliant lights spring into an effulgence that illumines the heavens for miles and miles around, one marvels at man's inventive genius. At the same time one may pause to reflect upon the days that went before, upon the persevering industry of those early experimenters who by the very persistence of their efforts laid the foundation of a twentieth century civilization beside which the fabled story of Aladdin and his lamp sinks into the commonplace. Artificial light may well be acclaimed the greatest factor in the development of civilization. To quote Dr. Luckiesh: "This is in reality the age of artificial light, for mankind has not only become independent of daylight in certain respects, but has improved upon natural light. The controllability of artificial light makes it superior to natural light in many ways. In fact, uses have been made of artifical which are impossible with natural light."

Its record of accomplishment is a chapter from the book of magic. It is a factor of safety as well as of personal convenience, to say nothing of world progress. Up to a few generations ago travel by land, even to passing through the streets of city or town, was available during the daytime only to the peaceful citizen who feared to run the risk of accident or violence. The way upon the sea was hazardous indeed during the silent watches of the night. Today it is all different. Brilliant street-lighting has made the city street as safe by night as by day. Upon the sea powerful searchlights penetrate the night atmosphere for miles around the vessel, and these, when equipped with shutters, are used for code signalling from one ship to another or between the ship and the shore. Lighthouses, light-ships and light-buoys distributed along seacoasts, rivers and channels are equipped with modern lighting apparatus that make them God-sends to coasting vessels. Similar signal-



The Great White Way, Market Street, San Francisco

lights are used ashore for the convenience of railroad travelling.

With regard to the commercial pursuits of life, artificial light has established the twenty-four-hour day. No longer does the factory discharge its human content at sundown and lie idle till the dawn. Manufacturing activities and most trades are now prosecuted continuously, working-shifts changing at regular intervals regardless of day or night. Furthermore, modern artificial light makes for increased efficiency. It enables the workman or workgirl to turn out more and better work, and in the saving of eyestrain and the creation of an atmosphere of healthful as well as pleasant surroundings it helps to preserve the well-being of the worker and make him or her cheerful of spirit. The eight-hour span of toil has most of the element of drudgery taken from it. The great industrial development of the present time owes more to artificial light than to any other factor. Here, too, the element of safety comes in, for a well-lighted factory is in itself an insurance against industrial accident.

Artificial light plays an important part in modern therapeutics. Light-rays are used as germicides, and wounds are treated, water sterilized by these means. The Roentgen ray penetrates the human frame and lays its interior open to inspection. Luther Burbank is authority for the opinion that electric light has an immense influence upon plant life. Artificial light, both gas and electricity, is playing an important part in the poultry industry, for it has been discovered that artificial light during the dark months of the year has increased egg production enormously. Artificial light has been a great factor in the practical development of photography. In fact, its record of accomplishment in the every day concerns of life is gathering volume by the hour.

Recreational activities owe much, some their very existence, to artificial light. Tennis, for instance, can now be indulged in by the aid of powerful reflectors which illumine the court as effectively as the sun in the noonday. What the modern theatre would be without electric light one can readily imagine when one's mind travels back to the days of gas flare and lamp-smoke. Our latest and most active theatrical enterprise, the motion picture, owes everything to the modern lighting apparatus through which the pictures are projected upon the screen. Then, in the home. Modern light makes reading a recreation, not a toil. Schools, libraries, art museums, other places of intellectual instruction no longer depend upon the hours of daylight for their attendance. The home itself reaches the highest point of attractiveness by means of modern arificial light. The campaign for better lighted homes is a never ending one. It is in full progress throughout this country today. Educational literature is being distributed far and wide. Experts are employed to instruct all good citizens upon the difference between good and bad lighting, upon the artistic beautification of the home through better lighting conditions, upon every point, in fact, in which the best artificial light may contribute to the general joy of living.

The books tell us that light is everywhere the symbol of joy and life-giving power, as darkness is of death and destruction. We who live in this age of wonders realize the wisdom of that saying and it strikes home to us with increasing clarity as we move on and on.

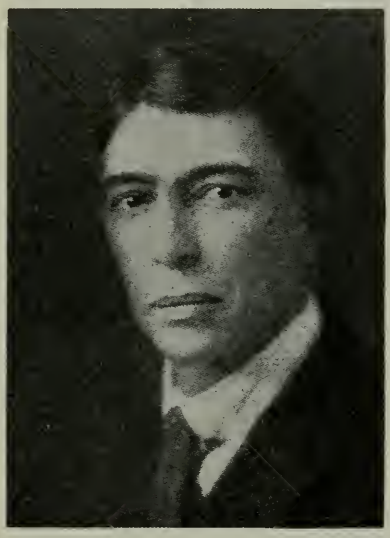


The "Path of Gold"—Market Street, San Francisco, decorated as well as lit by electroliers

"Service" The Watchword of the P. C. G. A. Convention at Santa Barbara

"Service, first, last, all the time." It is the watchword not only of the public utility but, also, of the manufacturer, the manufacturer's agent, the dealer, every individual and combination of individuals, in fact, whose business it is to serve the public, directly or indirectly.

Similar comment was made in these columns in a description of the convention of the Pacific Coast Electrical Association at Coronado last June, and it is once more in order in drawing attention to the 31st annual convention of the Pacific Coast Gas Association which took place in Santa Barbara last month. The problem of public relations, involving contact with the public, service to the public, satisfied consumers, every point, in fact, from which this all-important subject could be discussed, was in evidence everywhere, and a conspicuous feature of the convention program was the session held under the auspices of the Public Relations section, now one of the four major divisions of the Association's activities.



The Association's new president, E. L. Hall, of Portland, Oregon

At this the report of the Committee on Employees' Relations with the Public, W. H. Barton, of Portland, Ore., chairman, brought out the leading points of this problem which is engaging the attention of public utility executives today more, perhaps, than any other. These points included the proper selection of employees, the training of all employees toward the development of an efficient and effective organization, co-operation among employees for the general benefit, active interest on the part of employees in civic enterprises and affairs, in a word, the continual development of the employee into an active and responsible participant in the never-ending campaign for the public good-will.

Along similar lines were the reports of the Committee on Customer Ownership, the Committee on Information and the Committee on Management. The first, presented by Mr. Frank A. Easton as chairman, dealt mainly with the sale of stock to employees, taking for its inspiration the idea that "a good salesman must first be sold on his own goods." The second, prepared by Mr. C. A. Luckenbach, chairman, dealt with the familiar topic of educating the public. The third, presented by Mr. J. P. Coghlan, of our company, dealt with accident prevention and welfare. Following these came an address by Mr. E. G. McCann, also of "Pacific Service," on "Human Relations as a Function of Management." This dealt with the treatment of employees not as groups of individuals but as individuals themselves, a means of bringing the management and the men together. In presenting this idea the speaker called attention to the Employees' Welfare Committee, an integral part of the working organization of a well-known California public utility and at whose sessions the president of the company sits not in any ruling capacity but as an ordinary member, ready to listen to and exchange ideas with every member of the committee.

It is an interesting problem, this of public relations, and it is in process of being solved. The way is not always easy, but there is an earnest determination on the part of public utility managements to arrive at a point where the public utility and the public it serves may be brought

together in a spirit of mutual confidence and understanding.

It was an unusually representative gathering that President Harold Basford addressed on opening day. There was a registered membership attendance of 270, including representatives of twenty-four Pacific Coast gas companies, a number of manufacturers and jobbers and four representatives of public service commissions on the Coast. Registered guests to the number of 56 brought the total registered attendance up to 326. In order to do justice to the excellent program parallel sessions of the Technical, Commercial and Accounting sections were held during three days of the week. This was the first year of an organized Commercial section and the discussions covered the important fields of Advertising, Merchandising, Home Service and the Industrial Utilization of Gas. The paper presented by the Advertising Bureau was on "Making the Public Think About It," a subject which speaks for itself. The report of the Merchandising Bureau was presented by Mr. A. L. Crane, of San Francisco, and had to deal with general improvement in merchandising methods through both gas companies and gas appliance dealers. The report of the Home Service Bureau, presented by Mr. W. M. Henderson, of Los Angeles, was another outstanding feature of this division. A novelty introduced was an address by Mrs. Kate Brew Vaughn upon the women's viewpoint of the gas business. In this Mrs. Vaughn showed thorough knowledge of the situation in the home and presented some valuable suggestions for the good of the industry. Another day there was a speaking contest conducted under the auspices of the Commercial Section during luncheon, when eleven speakers from five states and one territory competed for a prize upon the subject of "Value of a Sales Force to a Gas Company." The Award Committee, consisting of the mayor and two other prominent citizens of Santa Barbara, gave the prize to Mr. J. Earl Jones, of Portland, Ore., who gave a pleasing exhibition of a salesman knowing what he had to say and doing it within three minutes.



Clifford Johnstone, San Francisco, executive secretary of the P. C. G. A.

The Commercial section received well-merited recognition of its excellent work when its chairman, Mr. L. F. Galbraith, a "Pacific Service" man, was presented with the Basford perpetual trophy for the best section report at the convention.

The sessions of the Technical section were remarkably well attended and the greatest possible interest evinced in the matters under discussion. One paper deserving of special notice was that of Mr. R. S. Fuller, of our company's Department of Gas Operation and Construction, on "The Comparative Cost of High Pressure and Low Pressure Distribution." This was of special value to the industry for the reason that it set forth the advantages of high pressure distribution from a central plant over local plant distribution from the important standpoints of uniform pressure and general improvement of service, to



Chairman Galbraith of the Commercial Section in the convention

say nothing of reduction in capital investment. Another useful paper was the report of the Committee on Naphthalene Removal, presented by Mr. K. C. Tomlinson of Los Angeles. An equally important matter discussed in the Technical section concerned methods suggested for better pipe protection and, through that, reduction of losses from leakage.

In the award of honors on the closing day of the convention gold medals were given for the reports presented, respectively, by Messrs. Fuller and Tomlinson. The report of the Advertising Bureau, already mentioned in connection with the Commercial section, also received a gold medal. Honorable mention was given the reports of the Committee on Employees' Relations With the Public, Committee on Customer Ownership, the Home Service Bureau and the Merchandising Bureau, already mentioned. In addition, the Committee on Contracts and Work Orders, Mr. F. L. Nagel, chairman, received honorable mention, as did a paper by S. H. Christopher on "Soil Corrosion," a paper by M. J. Cereghino on "Fire Brick and Refractories" and a paper by H. L. Masser on "Reformed Gas."



Wm. Baurhyte, of Los Angeles, past-president of the P. C. G. A., a constant attendant at these conventions

The week was one of recreation as well as business. The golf committee held sway during a part of the time with a most interesting handicap tournament in which first honors were carried off by Mr. Paul Overton, attorney for the Los Angeles Gas & Electric Corporation. On the closing night there was the customary banquet at which the retiring president, Mr. Basford, officiated as toastmaster. Our guests were admitted to the banquet and it was a most enjoyable affair all around. Next year the convention takes place in Portland, Ore.

Following the custom already adopted by our electrical brethren the election of officers for 1924-25 took place on the opening day. The following were chosen by the nominating committee and duly elected: President, E. L. Hall, Portland, Ore.; Vice-President, F. J. Schafer, Los Angeles; Executive Secretary, Clifford Johnstone, San Francisco; Directors: H. R. Basford, San Francisco, A. B. Day, Los Angeles, W. S. Yard, San Francisco, G. E. Whitwell, Tacoma, J. E. Kelly, Stockton, S. R. Hutchinson, Seattle, H. M. Crawford, San Francisco.

President Hall has already announced his committee appointments, all bearing the approval of the Board of Directors. Mr. C. W. Platt is reappointed chairman of the Accounting section, Mr. Don C. Ray of "Pacific Service" officiates again as chairman of the Public Relations section, Mr. W. S. Yard, our company's Vice-President in Charge of Gas Construction and Operation, once more presides over the activities of the Technical section. Mr. G. E. Whitwell, of Tacoma, appears as chairman of the Commercial section. Other appointments: F. A. Rasch, Portland, chairman of the Sports Committee; R. M. Ranyard, Los Angeles, chairman of the Membership Committee; W. F. Herdrich, Los Angeles, Wrinkles Editor; John Clements, Oakland, Experience Editor; Papers Committee: F. S. Wade, Los Angeles, R. E. Fisher, San Francisco, G. E. Whitwell, Tacoma; Auditing Committee: W. H. Barton, Portland, O. L. Moore, Los Angeles, D. J. Young, Tacoma.

The Pacific Coast Gas Association, while in its thirty-second year of existence, may still be regarded as an infant, for manifestly it has not stopped growing. Its membership roll now stands at 875, embracing representatives of every branch of the gas industry, and of this total 120 new members were elected at the Santa Barbara convention.

The Financial Side of "Pacific Service"

Following is a condensed statement of the Company's income account for the nine months ended September 30, 1924, compared with the same period last year:

	Nine Months Ended September 30th	
	1924	1923
Gross Revenue, including Miscellaneous Income	$33,272,970.71	$29,640,350.80
Maintenance, Operating Expenses, Rentals, Taxes (including Federal Taxes) and Reserves for Casualties and Uncollectible Accounts	20,966,054.39	17,195,404.04
Net Income	$12,306,916.32	$12,444,946.76
Net Interest Charges	4,696,867.34	4,634,881.44
Balance	$ 7,610,048.98	$ 7,810.065.32
Bond Discount and Expense	281,128.56	243,393.19
Balance	$ 7,328,920.42	$ 7,566,672.13
Reserve for Depreciation	2,398,322.11	2,556,699.03
Balance to Surplus	$ 4,930,598.31	$ 5,009,973.10

Gross revenues in the first nine months of the current year increased $3,632,619.91, the additional business being divided about evenly between the electric and gas departments. This large increase in gross revenue was, however, absorbed by the increased costs of operating steam stations to meet the deficiency in the production of hydro-electric energy arising out of the abnormal and almost unprecedented water shortage prevalent throughout California during the present year, seasonal precipitation having been only 40 per cent of normal. The fact to be emphasized, however, is that this year's water shortage is a temporary, one might almost say an accidental, condition, whereas the large amount of new business taken on is substantially all of a continuing character and will contribute markedly to net revenues as soon as the usual fall and winter rains restore normal operating conditions. By means of scrupulous supervision of expenses and the exercise of the most rigid economies in every direction the Company succeeded in keeping its remaining operating costs at substantially the same level as last year, notwithstanding that the volume of business transacted was approximately one-eighth more than in the first nine months of 1923. The Company finds some satisfaction in the fact that it has been able, in the face of extremely adverse operating conditions, to meet every demand made upon it for power; and to accomplish this feat without asking for any increase in rates to offset the enormously increased expense involved through the burden imposed upon it of not only operating its own steam-electric generating plants to their utmost capacity, but of leasing and bringing into service practically every available steam plant which could be connected to its distribution system throughout Northern California. Substantial rainfalls during the past few days have already resulted in a perceptible improvement in operating conditions.

Interest charges of $4,696,867.34 in the first nine months of this year were earned 2.62 times, and the surplus of $4,930,598.31 available for dividends, after the payment of all fixed charges and depreciation, was only $79,374.79 less than in the corresponding period of 1923.

LARGE INCREASE IN CUSTOMERS AND SALES

The Company during the month of August made a net addition of 5,531 customers to its lines, this being the largest gain in active meters during any month of the current year. The total number of customers receiving service at the close of August was 742,971. The remarkable growth of recent years is reflected in the net gain of approximately a quarter of a million consumers in the past five years alone, the Company having added during this comparatively short space of time one-half as many customers as during the entire previous corporate history, extending back over a period of about seventy years, of Pacific Gas and Electric Company and its predecessor corporations.

Sales of both gas and electricity continue consistently to exhibit a very satisfactory growth. In the month of August sales of electricity increased 13,963,089 kilowatt hours, or 12.32 per cent over August, 1923, and in the first eight months of this year electric sales increased 97,723,184 kilowatt hours, or 12.47 per cent. In the Gas Department sales during August showed an increase of 117,045,200 cubic feet, or 12.19 per cent, and in the eight months ended August 31, 1924, increased 1,063,554,800 cubic feet, or 11.72 per cent. It is interesting to note in this connection that the Company sold more gas in the first eight months of 1924, that is, in two-thirds of the current year, than in any entire twelve months period prior to 1920. This increase of approximately one-third in volume of gas sales during a period of less than five years is entirely the result of normal growth and of creative sales effort, no existing gas properties having been acquired by the Company during this period.

RECENT FINANCING

On July 9th, 1924, the Company invited subscriptions from its stockholders to an issue of $5,000,000 par value of its Common Stock, at $93 per share. The issue was not underwritten. The offer expired August 1st. Within a period of three weeks, aggregate subscriptions of approximately seven and three-quarters millions of dollars were received. Owing to the large over-subscription, none tendered after August 1st could be considered. The actual number of subscriptions received within the time limit and accepted was 3,693, aggregating $7,165,000. The stock was well distributed, the average subscription being less than 20 shares each.

A few weeks later the Company availed itself of the opportunity afforded by the strong market for high-grade bonds to sell, upon favorable terms, an additional issue of $12,500,000 par value of its First and Refunding Mortgage Series "C" 5½ per cent Gold Bonds. The sale of these securities placed the Company in an exceptionally strong position with respect to working capital.

Our construction program in the Pit River region and in other parts of our territory is quite heavy, but the present cash balance should be sufficient to take care of construction requirements during the remainder of the current year and well into 1925.

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF
A. F. HOCKENBEAMER - BUSINESS MANAGER

Year's subscription - - - - - - $1.50
PACIFIC GAS AND ELECTRIC COMPANY
445 Sutter Street, San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVI OCTOBER, 1924 NO. 2

EDITORIAL

Any citizen of our great commonwealth who, while honest and well-meaning in himself, is by temperament so susceptible to outside influence as to lend ear to the political agitator and professional reformer with his never-ending campaign of insidious propaganda against corporations, combinations of capital and any and all enterprises that make for general stability and prosperity, would do well to attend any one of the many conventions held during the working year at which men engaged in various branches of the public service get together and exchange ideas for their general benefit and that of the particular industry they represent.

In the July number of PACIFIC SERVICE MAGAZINE attention was called to the public relations problem that dominated all deliberations at the electrical convention at Coronado a month previous. In the present issue is found comment of similar import upon the recent gathering of men of the gas industry at Santa Barbara. A visit to either of these assemblies would have opened the eyes of almost any doubting Thomas as to the real situation in the public service today. There exists in certain quarters, may always exist here and there, a conviction that the "public be damned" principle still obtains among the public utilities, behind closed doors, at least, no matter what protestations to the contrary may be made in the open; but the fair-minded attendant at any public service convention of today may see for himself that the ruling thought, the dominant topic of discussion, is not how little but how much can be done to satisfy the consumer. It is no longer a question of "getting by." On the contrary, extraordinary pains are being taken in every department of the public service corporation today to see to it that no consumer shall be sent away dissatisfied, that, if anything, he shall receive even fuller service than he demands. He would find, too, that such policy is observed by the average public utility employee as not one of compulsion but voluntary to the point of enthusiasm. In other words, it is not a policy dictated by fear but by the honest desire to serve.

It shows the trend of the times. It is a question of evolution, of progress. It represents, in part, the march of our twentieth century civilization. It is born of the knowledge that in order to insure the prosperity of any community the public service must walk hand in hand with the public in sympathy and understanding. It is a deep-seated realization of what life means and should mean to the average citizen of the times.

The true conditions in the public service are very well known to most people. Nevertheless, the political agitator and reformer before referred to is always abroad in the land. He works early and late in his endeavor to accomplish his end, whatever it may be. The welfare of the community at large means nothing to him; he is solely interested in gaining his own personal point, in attaining his own personal objective.

Two years ago the voters of California by an enormous majority rejected the so-called Water and Power Act which sought to turn the public utilities dealing in water and power over to a small body of political appointees with unlimited power to bond the State, with an issue of $500,000,000 merely as a starter. As said, the voters rejected this proposal to socialize the industries of California, to blanket mortgage its credit and, at the same time, to turn something like a billion dollars' worth of property into the tax-free column. But, undaunted by this experience, the same people are out again with the same old measure which, if public attention were not called to it, might escape observation, as its number, 16, places it a considerable dis-

tance down a lengthy ballot. Any oversight in such a case might work injury, for the supporter of this iniquitous measure may be counted upon to seek it out before anything else.

Most of our readers remember the campaign of two years ago and what was said for and against this measure. There has, however, been prepared by Senator Arthur H. Breed, President pro tem of the State Senate of California and, consequently, a man well versed in matters pertaining to legislation, an official statement which has been filed with the Secretary of State at Sacramento. Under present conditions we feel justified in laying this statement before our readers in full text, as follows:

"The pending water and power constitutional amendment is the same measure which the people rejected two years ago by a majority of nearly 354,000.

"It pledges the State's credit to an issue of $500,000,000 of tax-free State bonds. A board of five persons, appointed by the Governor, would spend the money in acquiring, operating and maintaining such water and power projects as it deemed necessary or convenient.

"This political board would operate the projects from Sacramento, fix rates and determine conditions and quality of service, all without regulation by the Railroad Commission. Consumers and communities would thus be at the mercy of five politicians with a virtually unrestrained control of industry. Should incorrect estimates, inadequate service or political mismanagement prevent projects from paying expenses or meeting interest charges or requirements for repayment of principal out of rates, explicit provision is made to meet deficits and losses out of the general funds of the State.

"The board is empowered to appoint such employees as it may require and fix their compensation. These employees are exempted from the State civil service law, so that the board can build up a great political machine through patronage.

"This year advocates of the measure seek to take political advantage of the drought by masking the water and power amendment as a water conservation plan. But, public ownership will not increase rainfall. Behind the existing dams the storage basins are almost dry. What California needs is more rain, not more empty reservoirs.

"There is no public need for the State to embark in the power business and no good reason for adding half a billion dollars of tax-free bonds to the huge volume of such securities outstanding. Many advocates of the water and power measure, undismayed by the failure of North Dakota in the wheat and banking businesses, favor the act as a first step in California toward the taking over by government of essential industries and the redistribution of private wealth through taxation. There is no more reason why the State should adventure into the power business than into the flour or automobile business.

"Less than fourteen years ago the State undertook effective regulation of public utility companies. As a result the rates, investments and service of such companies are now controlled by a public agency. To scrap the policy of regulation and substitute public ownership would be unjust and foolish. Even those who assert that regulation has failed cannot logically offer as an improvement a new commission appointed like the Railroad Commission by the Governor and given the insufficiently restricted power of expending the taxpayers' money and hiring armies of employees.

"Private initiative and effort developed California. Political management is usually wasteful and inefficient, and to compel taxpayers to provide enormous amounts of borrowed money for the financing of unspecified ventures by a political machine would be to invite disaster.

"The voters should rebuke by a majority larger than before the restless agitators who refuse to accept the decision of the people so emphatically expressed. Repeated submission of such measures is a public nuisance and tends to bring the initiative into disrepute.

"A. H. BREED,
"President pro tem. California Senate."

It is a significant fact that the very great majority of really prominent public men in this country are emphatic in their opposition to any such legislation. The Chief Justice of the United States not long ago made the following comment:

"The intervention of politics always increases the cost of operation, and leads to unwise management. Many who favor

municipal operation admit that the present system cannot be continued by municipal and state governments without a constant loss. They propose that the losses be made up by taxation. But our experience in public control of that kind of activity and complicated business management has not been fortunate. It foreshadows such lack of economy and increase of cost of operation as to make the change most unwise."

Secretary Herbert Hoover expresses his opinion as follows: "We have outdistanced all the world in electrical development. Invention and industry have developed so that despite the increase in cost of labor and material the cost of power is very little higher than during the pre-war period. I have no taste for government operation and distribution of electrical power. The talk about it is generally due to a lack of understanding of the practical aspects of the industry."

Dr. Arthur T. Hadley, president emeritus of Yale University, read a paper before the World Power Conference in London last summer in which he said things directly applicable to the problem confronting the voters of California:

"Industries," he observed, "are of two kinds, the standardized and the progressive. In the standardized type, of which the post-office, the telegraph or the municipal water supply are examples, a large part of the work is a matter of routine. Honest administration and faithful performance of service are the all-important conditions. The capital invested is either small in proportion to the year's business, as in the post-office, or subject to easily calculated depreciation charges, as in the water supply. In the progressive industries all these conditions are reversed. The success of the work depends upon something more than the performance of routine duties. The amount of capital involved is large. Depreciation cannot be accurately calculated. New inventions and new methods often render the plant obsolete before it is worn out. The year's budget does not and cannot accurately reflect the year's conditions.

"The history of state owned industries shows that government does relatively well with standardized industries and relatively ill with progressive ones. Among the large industries of the present day the one which is least standardized and most progressive in its character is the electric power industry."

Last, but not least, among the big men comes President Coolidge in his Philadelphia address on September 25th, in which he said:

"With railways and electrical utilities under political control the domination of a group would be so firmly entrenched in the whole direction of our government that *the privilege of citizenship for the rest of the people would consist largely in the payment of taxes.*

"These utilities are no longer in the hands of the few, directly or indirectly. They are owned by millions of our inhabitants. It would mean a loss in public revenue estimated at $600,000,000 a year, and while in industrial States it might not increase the tax on the farmer more than there or four per cent, in many agricultural counties it would run as high as forty per cent.

"When we recall the appalling loss and the difficulty in the management of the $3,500,000,000 worth of ships, we should undoubtedly hesitate about taking on ten times that value in public utilities."

Chambers of Commerce from one end of the State to the other have passed resolutions denouncing this measure which stands before the voters of California. The majority of newspapers opposed to it is very large. Taking one as an example, the *Bakersfield Californian,* after analyzing the provisions of the measure, observes:

"Its proponents are seeking to impress upon the farmers and the people generally of the State that it is a water conservation plan as well as a power plan, trusting to create the thought that under the operation of such a plan there would, in some inscrutable way, follow an increase of moisture in the watersheds of the rivers that drain into the valley.

"The voters of the State should make no mistake as to the nature of the thing that is proposed. They must realize that the adoption of this plan, in addition to saddling the State with an enormous indebtedness, would scrap the policy of regulating well-conducted private enterprises, a regulation that includes distribution and charges, and substitute therefor that sort of public ownership that brought some northwestern states to the verge of ruin."

PACIFIC GAS & ELECTRIC COMPANY

A California Corporation

Managed by Californians Operated by Californians

"PACIFIC SERVICE" REPRESENTS (AS OF AUGUST 31, 1924)

11,661	employed in all departments
$239,000,000	capital invested in gas, electricity, railroads, steam, water and telephone plants.
59,000	square miles of territory in which it operates—an area greater than that of England and Wales.
30,000	stockholders.
38	counties of the State in which it transacts business.
742,971	consumers served with gas, electricity, water and steam.
2,158,000	people served in 38 counties, which is over 50 per cent of the State population.
291	cities and towns in which it supplies service directly and through other companies.
$18,730,245	annual wages paid employes, year ending August 31, 1924.
$3,015,136	taxes, state and county, year ending August 31, 1924.
$978,361	taxes, Federal Government, year ending August 31, 1924.
415,348	horsepower developed in 26 electric water-power plants.
192,688	horsepower developed in 5 electric steam plants.
608,036	total horsepower developed in 31 plants.
1,299,343,868	kw. hrs. sold, year ending August 31, 1924. This is equivalent to the effort of 4,331,000 men.
14,738,349,100	cubic feet of gas sold, year ending August 31, 1924.
18	gas plants.
12,040	miles of transmission and distribution lines. Greater than the distance between San Francisco and Colabar, West Africa.
3,760	miles of mains used in distributing gas. Greater than the distance between San Francisco and Santiago, Cuba.
1,100	miles of mains and ditches used in distributing water.
1,100	miles of track of street railway supplied with electric power.
65,374,091,546	gallons of water storage capacity in 109 lakes and reservoirs. This amount of water would supply the City of San Francisco at the present rate of consumption for nearly 5 years.
94,820	acres of land owned in California.
250	parcels of property owned in cities and towns.
5,889,571	barrels of California Oil used, year ending July 31, 1924.
180,091	horsepower in agricultural motors depending on "Pacific Service."
548,557	horsepower in mining, electric railways, manufacturing and other motors depending on "Pacific Service."
50,800	street lamps, gas and electric, lighted by "Pacific Service."
6,685,154	incandescent lamps nightly lighted.
1,329,488	horsepower connected to system.

PACIFIC GAS AND ELECTRIC COMPANY

Head Office: 445 Sutter Street
San Francisco

Branches in all principal cities and towns of 38 counties of North Central California.


OREGON
CALIFORNIA
NEVADA
PACIFIC OCEAN
DEL NORTE
HUMBOLDT
TRINITY
SISKIYOU
MODOC
LASSEN
PLUMAS
SIERRA
SHASTA
TEHAMA
GLENN
BUTTE
COLUSA
YUBA
NEVADA
PLACER
EL DORADO
AMADOR
CALAVERAS
TUOLUMNE
MARIPOSA
MADERA
FRESNO
MENDOCINO
LAKE
SONOMA
NAPA
SOLANO
YOLO
SACRAMENTO
SAN JOAQUIN
STANISLAUS
CONTRA COSTA
ALAMEDA
SAN MATEO
SANTA CLARA
SANTA CRUZ
MONTEREY
SAN BENITO
MERCED
ALPINE
Mt. Shasta
Lassen Pk.
Mt. Diablo
Lower Klamath Lake
Upper Klamath Lake
Klamath River
Eagle Lake
Middle Lake
Lower Lake
Clear Lake
Pyramid Lake
Tahoe
PIT RIVER PH. No. 3
PIT RIVER No 1
HAT CREEK P.H. No. 1-2
KILARC
COW CREEK
VOLTA
SOUTH
INSKIP
REDDING
GAS POINT
COTTONWOOD
RED BLUFF
DE SABLA
CHICO
CENTERVILLE
LIME SADDLE
COAL CANYON
OROVILLE
BULLARDS BAR
DEER CREEK
COLGATE
SPAULDING No 1 & 2
DRUM
GRASS VALLEY
NEVADA CITY
ALTA
COLFAX
WILLOWS
POTTER VALLEY
COLUSA
MARYSVILLE
WILLIAMS
PLUMAS
NICOLAUS
ARBUCKLE
WISE
HALSEY
AUBURN
Mt QUARRIES
LINCOLN
ROCKLIN
ROSEVILLE
FOLSOM
WOODLAND
DAVIS
SACRAMENTO
KNIGHTS LANDING
MADISON
CLOVERDALE
HEALDSBURG
GUERNEVILLE
MONTE RIO
SANTA ROSA
CALISTOGA
ST HELENA
WINTERS
VACA-DIXON
DIXON
SUTTER CREEK
IONE
JACKSON
AMADOR CITY
DRY TOWN
ELECTRA
OAKDALE
MODESTO
TURLOCK
PATTERSON
NEWMAN
LOS BANOS
MERCED
KERCKHOFF
SAN FRANCISCO
STATIONS A-K
OAKLAND
ALAMEDA
BERKELEY
SAN LEANDRO
HAYWARD
NEWARK
FT MARION
SAN JOSE
LOS GATOS
MORGAN HILL
GILROY
HOLLISTER
SAN JUAN
TRES PINOS
SALINAS
WATSONVILLE
SANTA CRUZ
APTOS
DAVENPORT
BEN LOMOND
SAN MARTIN
COYOTE
MT VIEW
SANTA CLARA
REDWOOD CITY
PALO ALTO
BURLINGAME
SAN MATEO
SOUTH SAN FRANCISCO
MARIN
NORTH BEACH
SAN RAFAEL
NOVATO
PETALUMA
SEBASTOPOL
HEALDSBURG
CLOVERDALE
UKIAH
LAKEPORT
HOPLAND
ASTI
CLEMENTS
CORDELIA
BIG BASIN
NEW HOPE
VALLEJO
BENICIA
MARTINEZ
CONCORD
PITTSBURG
ANTIOCH
BRENTWOOD
TRACY
LATHROP
RIPON
MANTECA
LODI
STOCKTON
ISABELLE
SAN ANDREAS
MOKELUMNE HILL
SPRING GAP
STANISLAUS
PHOENIX
TUOLUMNE
SONORA
JAMESTOWN
GROVELAND
BIG OAK FLAT
Mt. ALPINE
LEGEND
HYDRO-ELECTRIC STATIONS
STEAM STATIONS
ELECTRIC SUBSTATIONS
GAS GENERATING PLANTS
TRANSMISSION LINES
DISTRIBUTION LINES
WHOLESALED ONLY, BY P.G.&E.CO.
LINES UNDER CONSTRUCTION
INTERCONNECTING COMPANIES
N
POWER STATIONS
PRINCIPAL ELECTRIC SUBSTATIONS
GAS GENERATING PLANTS
AND
ELECTRIC TRANSMISSION AND DISTRIBUTING SYSTEM
OF THE
PACIFIC GAS AND ELECTRIC CO.
SAN FRANCISCO, CAL.
1924
0 12 24 36
S.P. Lawrence, Drs

"PACIFIC SERVICE"

IS FURNISHED TO OVER 742,000 CONSUMERS OF

GAS ♦ ELECTRICITY ♦ WATER

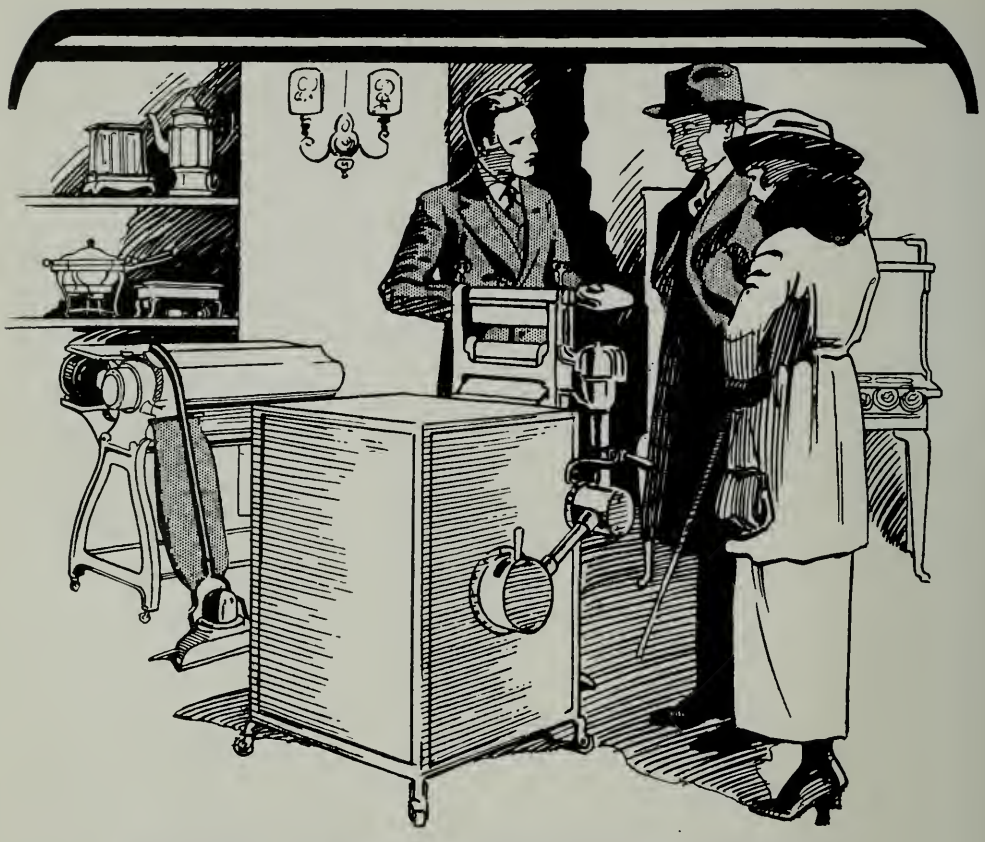
2,157,957 Total Population Served in Thirty-eight of California's Counties

CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL	
	No.	Population	No.	Population	No.	Population
Electricity	244	1,543,459	45	196,370	289	1,739,889
Gas	67	1,457,691	2	11,431	69	1,469,122
Water (Domestic)	24	87,300	5	14,100	29	101,400
Railway	1	83,000	.....	.....	1	83,000

Place	Population
[1]Alameda	31,000
[2]Albany	3,700
Alamo	100
Alta	100
Alvarado	1,100
Alviso	600
Amador City	750
Anderson	900
Angels	941
Angel Island	500
Antioch	2,600
Applegate	100
[6]Aptos	300
Arbuckle	900
Asti	100
[2]Atherton	600
[5-6]Auburn	2,500
Banta	50
[2]Barber	500
[2]Belmont	900
Belvedere	700
Benicia	2,750
[6]Ben Lomond	500
[2]Berkeley	70,000
Bethany	50
[6]Biggs	725
Big Oak Flat	750
Bolinas	300
Boyes Springs	750
Brentwood	400
[2]Broderick	700
Browns Valley	125
[2]Burlingame	8,000
Butte City	300
Byron	350
Calistoga	1,000
[2]Campbell	1,300
Camp Meeker	300
[2]Capitola	350
[6]Carmel	1,800
Cement	1,000
Centerville	1,750
Ceres	1,000
[2]Chico	11,000
Cloverdale	800
[5]Colfax	600
College City	250
Collinsville	300
[2]Colma	2,750
[5-6]Columbia	250
[2]Colusa	2,000
Concord	1,000
Copperopolis	300
Cordelia	350
Corning	1,800
[2]Corte Madera	800
[2]Cotati	400
Cottonwood	450
Coyote	200
Crockett	2,000
Crow's Landing	300
[2]Daly City	5,000
Danville	420
Davenport	500
[2]Davis	1 700
Dayton	60
Decoto	500
[6]Del Monte	300
Denair	400
[5]Dixon	1,000
Dobbins	100
Drytown	200
Duncan's Mills	250
Durham	400
[5-6]Dutch Flat	400
Dunnigan	300
Eldridge	500
[2-6]El Cerrito	1,600
Elmira	300
El Verano	400
[2]Emeryville	5,000
Escalon	700
Esparto	500
[2]Fairfax	600
Fairfield	1,050
Fair Oaks	400
Fall River Mills	250
Farmington	300
[5]Felton	300
Finley	100
Folsom	2,000
Forestville	300
[1]Fresno	79,500
Gerber	250
Geyserville	500
[6]Gilroy	3,500
Glen Ellen	1,200
[8]Gonzales	500
Graton	150
[3-8]Grass Valley	5,000
[8]Gridley	2,500
Grimes	500
[6]Groveland	400
Guerneville	1,000
Hamilton City	300
Hammonton	500
[2]Hayward	4,500
[6]Healdsburg	2,600
[8]Hercules	400
Hickman	40
[2]Hillsborough	950
[8]Hollister	5,000
Honcut	500
Hopland	500
Hughson	600
Ione	850
Irvington	1,000
[5-8]Jackson	1,900
[5-6]Jamestown	1,000
Kelseyville	600
Kennett	400
[2]Kentfield	750
Kenwood	300
Keswick	20
[6]King City	1,100
Knights Ferry	200
Knights Landing	400
La Fayette	250
[5]La Grange	200
Lakeport	1,200
[2]Larkspur	900
Lathrop	300
[2]Lawndale	60
Lewiston	150
[5-8]Lincoln	1,500
Live Oak	300
[5]Livermore	2,300
[2]Lomita Park	1,250
[5]Loomis	500
Los Altos	800
[2]Los Gatos	3,500
Los Molinos	300
Lylton	100
Madison	300
Manteca	2,000
Mare Island	400
Martell	50
Martinez	4,000
[2]Marysville	8,000
Maxwell	500
[2]Mayfield	1,500
McArthur	125
[2]Menlo Park	3,000
Meridian	250
[2]Millbrae	350
Mills	400
[2]Mill Valley	3,000
Milpitas	350
Mission San Jose	500
Modesto	14,500
Mokelumne Hill	237
[6]Monterey	6,000
Monte Rio	300
[6]Morgan Hill	950
[2]Mountain View	3,200
Mt. Eden	500
[2]Napa	6,800
[3-8]Nevada City	1,800
Newark	1,100
[5]Newcastle	750
Newman	1,500
Niles	1,800
Nord	60
[2-6]Novato	800
Oakdale	2,000
[2]Oakland	265,000
Oakley	200
Occidental	600
Orland	2,000
[3]Oroville	5,500
Pacheco	300
[6]Pacific Grove	3,500
[2-7]Palo Alto	8,181
Paradise	550
Patterson	800
Penn Grove	250
[5]Penryn	250
Perkins	350
[2]Petaluma	7,000
[2]Piedmont	5,000
[6]Pike City	150
[6]Pinole	970
Pittsburg	6,600
Pleasanton	1,100
Port Costa	1,000
Potter Valley	600
Princeton	300
[2]Red Bluff	3,300
[3-8]Redding	3,200
[2]Redwood City	4,500
[2-6]Richmond	35,000
Rio Nida	250
Rio Vista	1,100
Ripon	750
Riverbank	1,200
[5]Rocklin	650
[6]Rodeo	300
[6-8]Roseville	4,500
[2]Ross	800
[4]Sacramento	83,000
Salida	350
[6]Salinas	5,300
San Andreas	250
[2]San Anselmo	4,000
[2]San Bruno	2,000
[2]San Francisco	615,000
[2]San Jose	60,000
[6]San Juan	700
[2]San Leandro	7,500
[2]San Lorenzo	800
[6]San Martin	300
[2]San Mateo	8,500
[6]San Pablo	500
[2]San Quentin	3,000
[2]San Rafael	6,500
[6]Santa Clara	6,000
[6]Santa Cruz	16,000
[2]Santa Rosa	9,500
Saratoga	1,200
[2]Sausalito	3,500
[2]Sebastopol	1,750
Shawmut	300
Shasta	50
Shellville	200
Sheridan	250
Smartsville	300
[6]Soledad	400
[6]Soquel	825
Sonoma	1,000
[5-6]Sonora	3,000
[5]Soulsbyville	200
[2]South San Francisco	5 000
Standard	600
[2-7]Stanford University	3,250
Stanislaus	100
[5-6]Stockton	50 000
Suisun	800
Sunol	250
Sunnyvale	2,200
Sutter City	400
Sutter Creek	1,000
Tehama City	150
[5]Thermalito	250
Tiburon	500
Towle	50
Tracy	3,200
[6]Tres Pinos	350
[5-6]Tuolumne	2,000
Turlock	4,500
Upper Lake	600
[6]Vacaville	1,300
Valley House	200
[2-6]Vallejo	22,750
Vallicito	150
Vina	300
Vineburg	250
Walnut Creek	900
Warm Springs	300
Waterford	350
[6]Watsonville	6 000
[6]Weaverville	500
Wheatland	475
Williams	800
[3]Willows	2,300
Windsor	600
Winters	900
[2]Woodland	5,600
Woodside	300
Wyandotte	250
Yolo	400
[2]Yuba City	3,500
Total Cities and Towns	1,725,814
Add Suburban Population	432,143
Total Population Served	2.157.957

Unmarked—Electricity only.
[1]—Gas only.
[2]—Gas and Electricity.
[3]—Gas, Electricity and Water.
[4]—Gas, Elect. and St. Railways.
[5]—Electricity and Water.
[6]—Electricity supplied through other companies.
[7]—Gas supplied through other companies.
[8]—Water supplied through other companies.



FOR THE HOUSEWIFE-

WITH the washing done by a turn of the switch and baking automatic, all the hard jobs, such as ironing, scrubbing and sweeping are performed by the willing servant *electricity*—the housewife can then give her family all the refinements of comfort desired to make life quiet and easy, while keeping for herself many free hours for self-culture or amusement.

All this and more by the aid of the *electric appliances* now at your dealers.

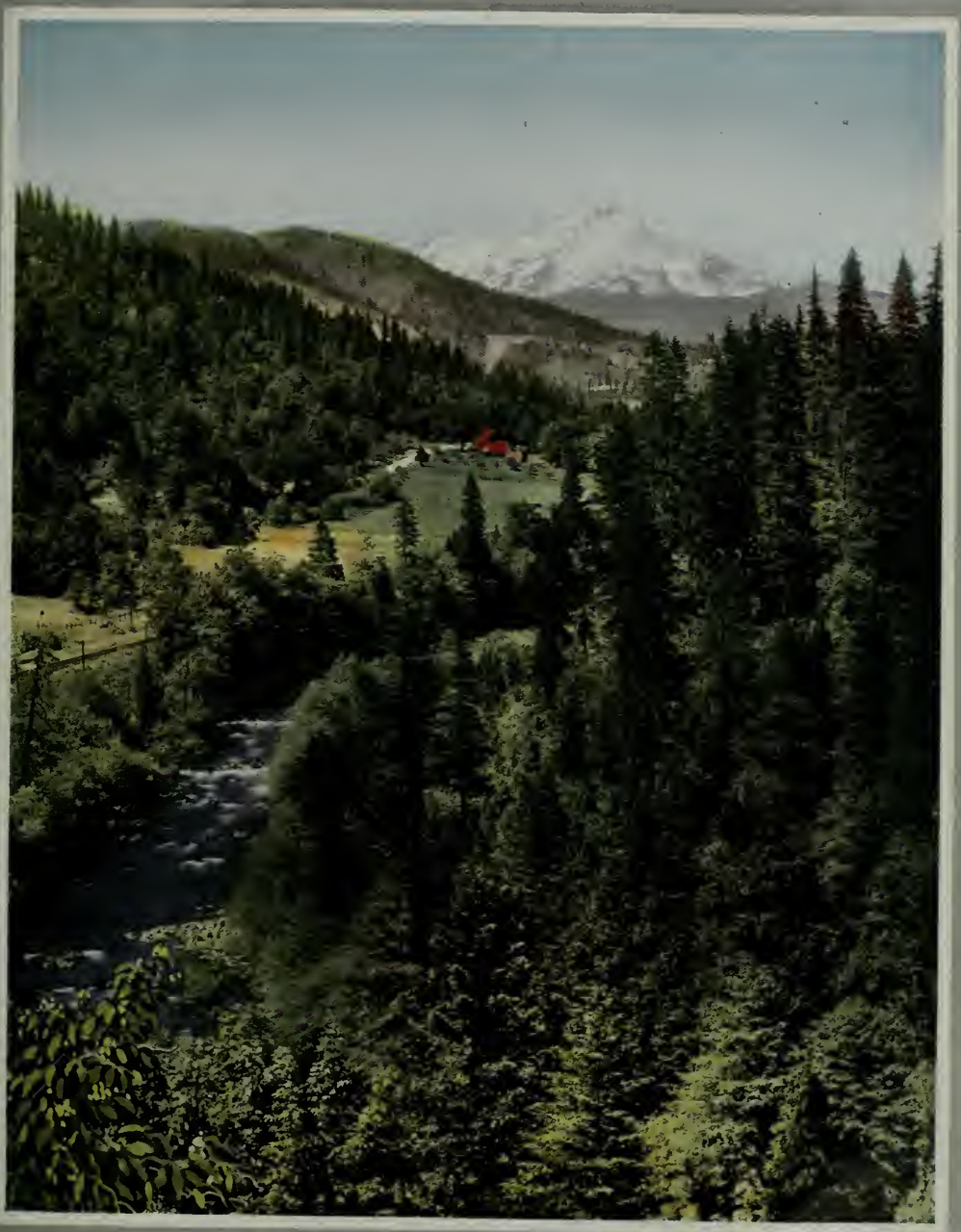
PACIFIC GAS AND ELECTRIC COMPANY

P·G·and E·

"PACIFIC SERVICE"

PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO SAN FRANCISCO



VIEW OF MT. SHASTA FROM UPPER SACRAMENTO

Vol 16 JANUARY 1925 No 3

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER
F. B. ANDERSON
CHAS. L. BARRETT
W. E. CREED
W. H. CROCKER
A. B. C. DOHRMANN
JOHN S. DRUM
F. T. ELSEY
D. H. FOOTE
A. F. HOCKENBEAMER
FRANK A. LEACH, JR.
NORMAN B. LIVERMORE
JOHN D. McKEE
JOHN A. McCANDLESS
C. O. G MILLER

OFFICERS

W. E. CREED . . . . . *President*
FRANK A. LEACH, JR. . . . . *First Vice-President and General Manager*
A. F. HOCKENBEAMER . . . . . *Second Vice-President and Treasurer*
D. H. FOOTE . . . . . *Third Vice-President and Secretary*
CHAS. L. BARRETT . . . . . *Assistant Secretary*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, JR., Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney . . . . . LAW DEPARTMENT
C. P. CUTTEN, Attorney . . . . . RATE DEPARTMENT
R. J. CANTRELL, Manager . . . . . PROPERTY DEPARTMENT
E. W. HODGES, General Auditor . . . ACCOUNTING DEPARTMENT
H. T. TERRY . . . . . CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager . . . . . CREDIT AND STOCK SALES DEPARTMENTS
JOHN H. HUNT, Purchasing Agent . . PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent . . . SUPPLY DEPARTMENT
E. G. McCANN, Manager . . . . PERSONNEL DEPARTMENT

ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT

O. W. PETERSON . . . . . Engineer of General Construction
E. H. STEELE . . . . . Engineer of Line Construction
F. R. GEORGE . . . . . Engineer of Operation
GEO. H. BRAGG . . . . . Engineer of Maintenance

DEPARTMENT OF ENGINEERING

J. P. JOLLYMAN . . . . . Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER . . . . . Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE . . . . . Chief of Division of Civil Engineering
F. M. HARRIS . . . . . Chief of Bureau of Specifications and Estimates
O. A. KNOPP . . . . . Chief of Bureau of Tests and Inspection

DEPARTMENT OF EXECUTIVE ENGINEER

F. C. PIATT . . . . . Valuation Engineer of Electric Properties
J. T. RYAN . . . . . Valuation Engineer of Gas, Water and Railway Properties
W. D. SULTAN . . . . . Rate Engineer
S. B. SHAW . . . . . Automotive Engineer
W. G. JACK . . . . . Manager Land Department

GAS CONSTRUCTION AND OPERATION DEPARTMENT

FRANK WILLS . . . . . Engineer of Production
R. S. FULLER . . . . . Engineer of Distribution
HARRY J. SMITH . . . . . Engineer of Construction

PUBLIC RELATIONS AND SALES DEPARTMENT

R. W. ROBINSON . . . . . Assistant to Vice-President in Charge of Public Relations and Sales
DON C. RAY . . . . . Manager Bureau of Public Relations
N. R. SUTHERLAND . . . . . Manager Commercial Department
H. M. CRAWFORD . . . . . Sales Manager
H. E. SANDOVAL . . . . . Manager Electric Sales
FORREST U. NAYLOR . . . . . Manager Gas Sales
J. CHARLES JORDAN . . . . . Manager Publicity Department

W. B. BOSLEY
General Counsel

JOHN P. COGHLAN
Assistant to the President

F. S. MYRTLE
Editor-in-Chief Pacific Service Magazine

DIVISIONS AND MANAGERS

DIVISION MANAGERS		DISTRICT MANAGERS	HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION		Marysville
		J. V. KYLE — Colusa District	Colusa
I. B. ADAMS	DE SABLA DIVISION		Chico
H. M. COOPER	DRUM DIVISION		Auburn
		L. H. HARTSOCK — Nevada District	Nevada City
L. H. NEWBERT	EAST BAY DIVISION		Oakland
		J. H. PAPE — Berkeley District	Berkeley
H. C. ROSS	FRESNO DIVISION		Fresno
H. G. RIDGWAY	NORTH BAY DIVISION		San Rafael
		L. J. PETERSON — Petaluma District	Petaluma
		C. D. CLARK — Napa District	Napa
		C. D. CLARK — Vallejo District	Vallejo
		M. G. HALL — Santa Rosa District	Santa Rosa
E. W. FLORENCE	SACRAMENTO DIVISION		Sacramento
		C. W. McKILLIP — Sacramento District	Sacramento
		C. E. SEDGWICK — Solano District	Dixon
		J. W. COONS — Yolo District	Woodland
HENRY BOSTWICK	SAN FRANCISCO DIVISION		San Francisco
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION		Modesto
		W. E. ESKEW — Electra District	Jackson
		C. R. GILL — Modesto District	Modesto
		J. H. FAGG — Stockton District	Stockton
		CHAS. H. NOACK — Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION		San Jose
		W. T. KELLOGG — Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION		Redding
H. B. HERYFORD	WEST SIDE DIVISION		Red Bluff
		STEPHEN GOIN — Willows District	Willows
		CHAS HUGHES — Red Bluff District	Red Bluff

Pacific Service Magazine

Volume XVI Number 3

Yearly Subscription, $1.50 Single Copies, Each 15 Cents

Contents for January, 1925



VIEWS OF AGRICULTURAL CALIFORNIA - - - - - - - - - - - *Frontispiece*

"PACIFIC SERVICE" AND AGRICULTURE—
ELECTRICITY AN INVALUABLE AID - - - - - - - *F. S. Myrtle* 67

PROGRESS OF PIT THREE DEVELOPMENT—
BORING THE FOUR-MILE TUNNEL - - - - - - - *O. W. Peterson* 73

DEVELOPMENT OF A GREAT GAS PLANT—
THE POTRERO, SAN FRANCISCO - - - - - - - *Harry J. Smith* 79

SOME INDUSTRIAL INSTALLATIONS OF INTEREST - - - - - - 84

COMPANY EMPLOYEES PROSECUTE VALUABLE
EDUCATIONAL WORK - - - - - - - - - - - - - - - - - - - 88

THE FINANCIAL SIDE OF "PACIFIC SERVICE" - - - *A. F. H.* 90

EDITORIAL - 92

IN THE PATH OF STATE DEVELOPMENT - - - - - - - - - - 94



In agricultural California. Two upper views are of 50-horsepower electric pumping plants. Beneath these, one of a well-irrigated orchard. The three following pictures are of typical ranch residences, all electrically equipped and served. The illustration at lower right is of an irrigation pipe manufacturing plant located near San Jose, electrically equipped and operated.

PACIFIC SERVICE MAGAZINE

Volume XVI JANUARY, 1925 Number 3

"Pacific Service" and Agriculture— Electricity an Invaluable Aid

By FREDERICK S. MYRTLE

The State of California has developed the application of electricity on the farm to a greater extent than any other section of the country, if not of the entire world.

Her position in this respect is due primarily to two contributing factors: first, cheap and available hydro-electric power; second, an elaborate interconnected system of transmission lines, traversing every section of the great interior valleys which are the chief agricultural regions of the state.

These facts were brought out at a conference held in San Francisco last May for the purpose of considering, from every available angle, the problem of the relation of electricity to agriculture. The conference itself was an outcome of a movement started in the previous year, when representatives of the National Electric Light Association met with members of the American Farm Bureau Federation to determine ways and means of answering the questions, "What can electricity do for agriculture? How can service be supplied to the farmer and what is involved in its establishment? How can service be utilized by the farmer so that it will be profitable for him?" The result of their deliberations was the formation of a national committee on the relation of electricity to agriculture, with Dr. E. A. White, an eminent agricultural engineer, as director.

The personnel of this committee was made up of representatives from the American Farm Bureau Federation, the National Electric Light Association, the Power Farm Association, the American Society of Agricultural Engineers and the United States Departments of Agriculture, Commerce and Interior. Its chief task was to determine the maximum economic uses of electricity in agriculture. The work was organized on a state basis, being distributed among state committees similar in organization to the national committee.

California's participation in the movement had its inception in May, 1924, at the meeting in San Francisco previously referred to. This meeting was attended by leaders of the California Farm Bureau Federation, executives of most of the California central stations, members of the staff of the College of Agriculture of the University of California and representatives of many of the large electrical manufacturers. At that time a California committee on the relation of electricity to agriculture was appointed with the following as its personnel: L. J. Fletcher, Agricultural Engineering Division, College of Agriculture, University of California, chairman; J. J. Deuel, Law and Utilities Department, California Farm Bureau Federation; B. M. Maddox, district manager, Southern California Edison Company, Visalia; C. A. Utley, the Pelton Water Wheel Company, and president of the Western Irrigation Equipment Association;



Reservoir and canal, part of an extensive irrigation system in the San Joaquin Valley.

A. M. Frost, commercial manager, San Joaquin Light & Power Corporation, Fresno; J. W. Nelson, secretary, California Farm Bureau Federation; H. M. Crawford, sales manager, Pacific Gas and Electric Company, San Francisco; N. R. Sutherland, Pacific Gas and Electric Company, San Francisco; E. O. Shreve, district manager, General Electric Company, San Francisco; B. D. Moses, Agricultural Engineering Division, College of Agriculture, University of California, executive secretary. This committee is now actively at work.



In the reclaimed Delta region near Stockton, California.

The State of California contains approximately one hundred and one million acres of land, of which the area considered to be suitable for cultivation is estimated at twenty-two million acres. Now, to properly cultivate these lands there must be water, and California with her wet and dry seasons has not in her natural streams the constant flow that gladdens the heart of the agriculturist during the five months of the year when irrigation is an absolute necessity. As a rule, from April to October of each year neither rain nor snow falls in California, so that when the supply of snow in the mountains is exhausted and run off in the various streams to the ocean there is little or no water flowing into the main rivers, particularly those that irrigate the two main arteries of the state, namely, the Sacramento and San Joaquin Valleys, save that which comes from storage and from underground springs. To the storage reservoirs, therefore, California looks for the supply that will keep flumes and ditches full during the arid months of the year when, without their help, thousands upon thousands of acres of farm and fruit lands would perish for want of life-giving sustenance. Those storage reservoirs are provided through the extensive development of hydro-electric power that has been in process since the first plant was established on the American River twenty-nine years ago and which is progressing today at an almost feverish rate to meet the demands of a fast growing civilization. From those storage reservoirs run flumes and ditches that irrigate fruit and farm lands alike, while that most wonderful of appliances to which, more than anything else perhaps, the farmer owes his present day prosperity, namely, the electric pump, has proved a veritable benefactor in the work of both irrigation and reclamation.



View on the Delta lands, where electricity has done wonders in reclamation work.

Irrigation has been aptly described as "crop insurance." Applied to conditions in California the descrip-

tion fits like a glove. From end to end of our Golden State there are long sweeping valleys of astonishing fertility that call for but intelligent cultivation to yield returns in boundless abundance. Modern science has pointed the way to intelligent cultivation and, given protection against Dame Nature's eccentricities, the California farmer can go his way contented. His protection, then, lies in irrigation, in the arid sections, and in reclamation in certain other sections of the country where the water supply promises to be too abundant at certain seasons of the year.



Prune dehydrator on a ranch near San Jose. Blowers operated by electricity.

Irrigation is not a new thing; neither is reclamation; but both sources of prosperity to the tiller of the soil in California were, to all practical purposes, uncertain quantities until that great upbuilder, that greatest of all developers, cheap electric power, was made available, and the legend, "electricity on the farm," came to be generally inscribed on the banner of interior development.

It should not be necessary to remind our readers that the use of hydro-electric power generated in the Sierra Nevada Mountains and transmitted through the interior valleys to the large cities has had a marked influence on the varied industries that give California her place of prominence among the progressive states of the Union. Hydro-electric power has had the effect of creating new industries that, from an economic standpoint, were not possible before its introduction, and it has given a stimulus to other industries that were languishing even unto the point of death before this great public benefactor came to their rescue. Electric power has rejuvenated the mining industry; it has dotted the landscape of the interior with factories; it has helped extract the precious gold from the river beds; it has made the cement industry a most important factor in the state's development; it has solved the domestic problem to the point of positive luxury. But, if there is one thing more than another it has done to confer an everlasting boon and a blessing to the state, it is the assistance it has given the farmer in his daily occupation and the protection it has afforded against the elements of risk that in early times made farming a somewhat hazardous occupation.



A modern ranch garden in the once submerged Delta lands reclaimed by electricity.

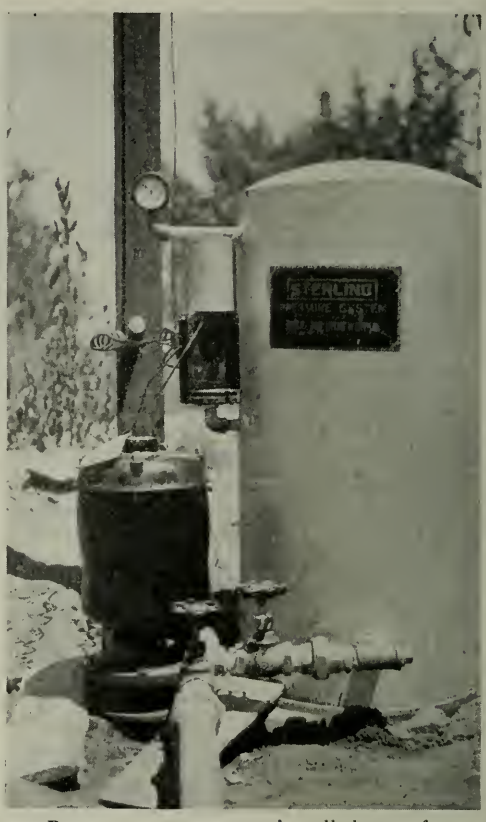
In a section of the country where Dame Nature provides an average of 300 days of sunshine every year it is indeed an advantage for the farmer to be able to turn on his own private rainfall whenever his fields require water. In this way sunshine and rain work together simultaneously and the result is shown in abundant crops. Let the visitor look for himself upon conditions as they are developing today in California. As he passes through our great valleys he sees on all sides large farms being cut up

into smaller tracts planted, variously, to fruit, vines, rice, alfalfa, grain, garden truck or some other crop that brings immediate and large returns to the farmer. If he looks farther he finds that the most important thing in connection with this intensified farming is the application of water to the land, and, going still one step farther in his investigation, that in a rapidly increasing percentage of instances the water is being pumped from wells and the pumping plants being driven by electric power.

An electric motor needs absolutely no attention—you just let it run. Therein lies the secret of its success. For, in these twentieth century days, the only new mechanical device that is worthy of serious consideration is one that insures a saving of time and labor. The California farmer remembers the time when he toiled in the fields from sunlight to sunset and took a scant living out of his holdings; today he basks in the sunshine of an abundant prosperity. And, if you will take him to one side and ask him the reason for his changed



An electrically equipped farm kitchen.



Pressure water system installed on a farm.

condition, he will tell you that it is due to cheap electric power.

In California today it is estimated that on the ranches there are 35,500 electric motors in operation. These motors total approximately 483,965 horsepower. Eighty per cent of them are used for driving irrigation pumps. With such an unusually large consumption of current, judging by middle western and eastern standards, the electric light, heat and power companies can afford to sell power at a low cost and still make a profit. As a result, there is a general use of electricity for lighting and barn power operations. In the interior valleys, where wood, coal or oil is not readily available, cooking to a large extent is done by electricity. The favorable climatic conditions of the far West encourage the use of electricity for this purpose and it is estimated that there are 10,000 electric ranges in use on California farms.

There are in California a total of 167,504 rural light and power consumers, that is, consumers outside of incorporated limits

of cities, who are served by 16,513 miles of rural distribution line, which is an average of 10.1 consumers per mile. Other figures which show the high electrical development of rural territory tell us that in California there are 23 inhabitants per rural consumer and .95 square miles of territory per rural consumer.



The College of Agriculture at the State University, Berkeley, California.

According to a national survey just completed, 2,185,000 new consumers were added to the central station lines of the United States during 1923. California, with an increase of 213,016 consumers, leads all other states. In 1922 a survey of the Pacific Gas & Electric Company's system showed that service was supplied to 12,500 agricultural consumers, cultivating a total area in excess of 450,000 acres, who consumed a total of 108,181,961 kilowatt hours or 240 kilowatt hours per acre. The total agricultural connected load on the Pacific Gas & Electric Company's system in September, 1924, was 177,715 H. P., and in September, 1923, 167,617 H. P., an increase for the year of 10,098 H. P.

For the year ending September, 1924, the sales on the Pacific Gas & Electric Company's system for agricultural power totalled 135,306,000 kilowatt hours, and for the same period in 1923, 99,205,000 kilowatt hours, an increase for 1924 of 36,101,000 kilowatt hours.

In the general spread of what may be called intensive farming throughout California our State University plays a by no means unimportant part. The College of Agriculture at Berkeley controls not only various agricultural experiment stations throughout the state but, also, as one of its major activities the University Farm School at Davis, where students are educated in every branch of practical farming, from the analysis and treatment of the soil up to the finished product. This farm school has already been described in PACIFIC SERVICE MAGAZINE, but it is worth more than a passing mention at this time for the reason that through its very thoroughness its activities in the way of research as well as of practical study have made it of inestimable value to the agricultural industry of the West. For, the knowledge and advice of those in charge of the various educational branches at this school are at the disposal of the agriculturist, whether he be a university student or not. It is for the great good of California and not for the advancement of the mere individual that this great institution is prosecuting its worthwhile labors.



Electricity helps the poultry industry in California. An electrically operated hatchery.

At Davis you will find electricity the motive power everywhere. Take, for instance, the Dairy Industry Building, the completest of its kind. Every labor-saving device connected with the dairy industry is installed in this building for the practical instruction of the student, and all of them run by electricity. Electricity runs separators, milkers, churns, sterilizers, pasteurizers, con-

densers, ice cream mixers, coolers, homogenizers, freezers, everything, in fact, at voltages running from 110 to 220. There is a large refrigeration plant, whose equipment consists of one twelve-ton and one seven-ton machine, the first run by a twenty-five horsepower motor, the second by one of fifteen horsepower. The milk for experiment work in this department is brought in from the outside, for the most part.

In this Dairy Industry Building a department of unusual interest is the bacteriological laboratory, where all kinds of chemical tests are made and to which is attached an incubator room where bacteria cultures are given a chance to grow. In this room a constant temperature is maintained by electrically-operated heating coils. In the testing laboratory there are installed centrifuge testers, one of which will do in one hour what it would take seven or eight hours to do by hand. Here electricity is again the moving impulse and in the laboratory there are a number of electric-heating devices, including vacuum pumps, etc.

When I was last at Davis, Professors Fletcher and Moses took me upon a personally-conducted tour of the Farm. I was not only impressed by what I saw then but, more than that, by the immense changes in the way of extension and improvement that are taking place there with incredible rapidity. You may pay a visit to the Farm, say, in the spring, and if you return there in the fall you are sure to find a number of new things of sufficient interest to make your visit worth the while. Just now they are paying a good deal of attention to irrigation. In the Irrigation Building, for instance, they are testing the water supply for the farm, they are testing the soil, they are preparing the land for irrigation and making investigation of the use and duty of water in irrigation, with particular study of the problem of soil moisture, all this to say nothing of numerous irrigation appliances which are installed there for practical experiment purposes.

In connection with the Division of Irrigation there is a practical course of outdoor study that deals with all the various forms of apparatus used in d[illegible]ting water, measuring it and distributing it over the land. There is a small reservoir from which run a main flume and side flumes. There are to be found various types of gates as well as of concrete pipe used for diverting and controlling the flow of water. There are also weirs, gauges, submerged orifices, water-wheels. In the way of measuring devices there are from twelve to fifteen different kinds.

The Agricultural Engineering Building at the Farm is a regular farm appliance warehouse where may be found every form of pumping device known to man. There is a very extensive irrigation system on a tract of 140 acres where four different pumping plants and a gravity system are interconnected so that a part or the whole system may be operated at any one time. Electric motors are directly connected to the pumps, which are located at different places on the tract, and their aggregate capacity is over 3,000 gallons per minute.

It may be said here that "Pacific Service" supplies the electric energy for operation of all the electrical equipment at the University Farm and the demand for this service is increasing steadily. Those in authority at the Farm will tell you what has been said here already, namely, that electric power is the most important factor of modern agricultural development.



The Dairy Industry Building at the University Farm at Davis.

Progress of Pit Three Development—Boring the Four-Mile Tunnel

By O. W. PETERSON
Engineer of General Construction, Department of Electrical Construction and Operation

The opening of 1925 *found the status of construction work at Pit Three development as follows:*

The diversion dam partly completed, with 60,000 *of the total of* 80,000 *yards of concrete in place.*

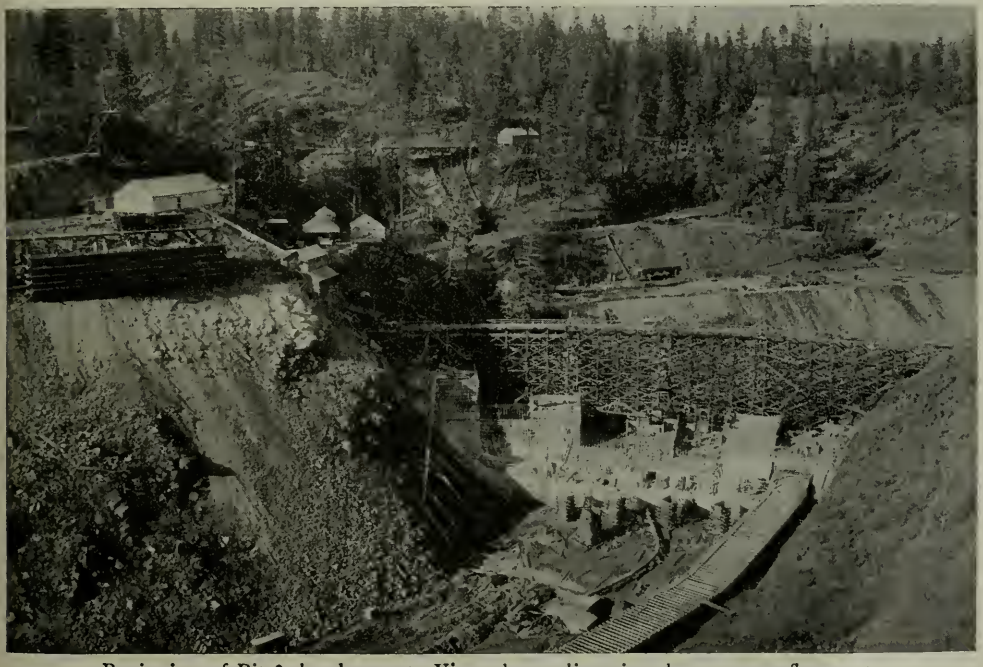
The four-mile tunnel between diversion dam and power-house bored and the work of concrete lining started.

The power-house foundation completed, the steel frame of the power-house in place, the work of pouring the concrete walls started and the assembling of electric generating machinery in process.

Transmission facilities completed by the construction of a line into Pit Three from junction with Pit One line at Hayne's Meadow, on the highway near the foot of Burney mountain.

The salient features of this hydro-electric project which, when completed, will add 107,000 *horsepower in installed capacity to our company's Pit River system, have been discussed at length in previous issues of* PACIFIC SERVICE MAGAZINE. *There is, however, one feature of the construction work that has not, perhaps, received an amount of attention proportionate to its importance; that feature is the four-mile tunnel. Not all of our readers know the engineering problems involved in boring through the earth a distance of four miles. Mr. Peterson, as our company's engineer of construction, has devoted the greater part of the subjoined article to a description of this tunnel work. We venture to think it will prove of unusual interest to our readers.*

—EDITOR PACIFIC SERVICE MAGAZINE.



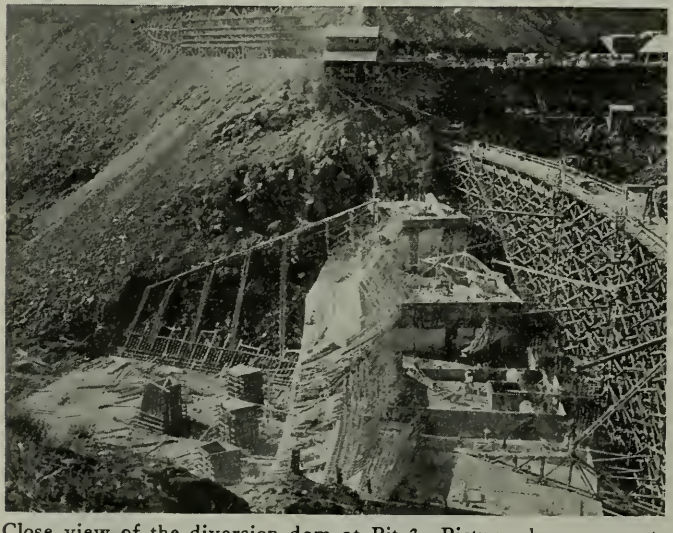
Beginning of Pit 3 development. View shows diversion dam, apron, flume, etc.

Pit. No. 3 involves in its larger elements a concrete diversion dam, a four-mile, concrete-lined tunnel of nineteen feet finished diameter, and a power plant of 107,000 horsepower installed capacity. In addition, before work could start on any of these construction features it was necessary to open up the country, as it were, with an eleven-mile extension of our Bartle-Pit River railroad down the river canyon, build ten miles of mountain roads, thirty miles each of power and telephone lines, and four fully equipped camps to house 1,500 men.



Tunnel boring nearing completion. Air shovels meet in headings 1 and 2

This preliminary work was planned and executed so that the facilities provided would be of the greatest value in building the main elements of the project. The railroad was laid on a route passing just above the diversion dam, past all points of work on Pit No. 3 tunnel, and directly to the power-house site. (From this terminus, extension will soon be started to our next project, Pit No. 4.) The four camps were established at the following points: Headquarters Camp near the dam site, to care for work at the dam and at No. 1 heading, Rock Creek Camp for miners at headings Nos. 2 and 3, Adit Camp for headings Nos. 4 and 5, and the Power-House Camp for the power plant and heading No. 6. At these camps and at the tunnel portals were assembled the usual shops, compressor and blower plants.



Close view of the diversion dam at Pit 3. Picture shows concrete plant, dam, apron, baffle piers and side walls to protect banks. Note boom chute lines with counterweight sections.

The building of a temporary timber crib diversion dam and of a large flume to divert the river from its channel was completed by August of this year. Since that date the foundations of the permanent dam have been excavated and nearly 60,000 of the total of 80,000 cubic yards of concrete in the dam have been poured. This work will proceed more slowly from now on,

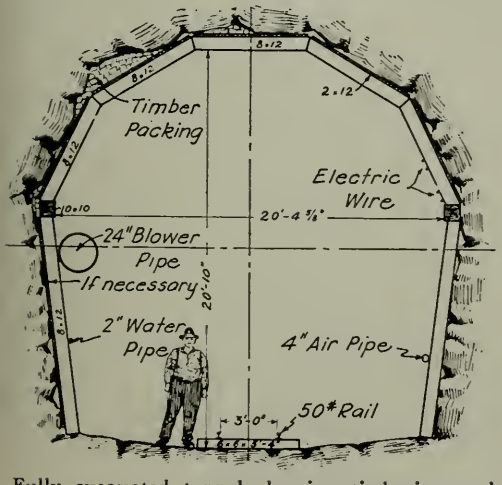
due to cold weather conditions and to the demand for our quarry output of crushed rock for tunnel lining. By midsummer the dam and three concrete arched roadway spans over its crest will be ready for traffic.

In the reservoir area of 1,500 acres extending seven miles upstream from the dam, crews of men have been busy during the past year clearing the brush and timber. When the reservoir is filled, the logs now cut, along with much timber which still stands around its border, will be floated to a saw mill near the dam site. There they will be cut into lumber for our next power project down river. Enough trees will be left around the border of the lake to provide enjoyable grounds for campers and to keep a pleasing scenic effect.

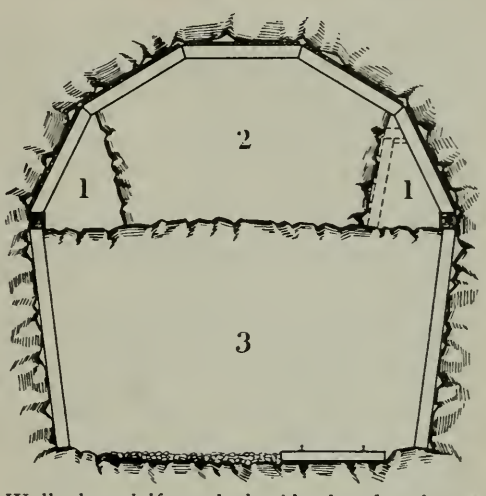
In the twelve months since work started at the power house site, the foundations of the building have been completed and the structural steel erected. Pouring of the building walls is now actively under way.

Since Pit No. 3 tunnel, considering both its carrying capacity of 3,000 cubic feet of water per second and its length of four miles, will be one of the most notable conduits ever built for power uses, and since its construction involved several unique features, both as regards formations encountered and methods used, a brief description of its boring may be of interest.

The tunnel, four miles in length, requiring a bore twenty-three feet high by twenty-two feet wide, cuts westerly through a broad bend of the river. Eight thousand seven hundred feet from its head it comes



Fully excavated tunnel showing timbering and packing, service pipes, wires and track



Wall plate drift method. Air shovel and cars are employed in mucking. Used in loose or broken formation

out into the open for a few hundred feet at Rock Creek Canyon, giving two additional portals. Four thousand six hundred and forty feet westerly from Rock Creek the tunnel line is tapped by a short horizontal adit, 192 feet in length, opening up two more portals. Thus the job was driven at six headings, No. 1 at the intake near the diversion dam site, Nos. 2 and 3 at Rock Creek, Nos. 4 and 5 at the Adit, and No. 6 on the mountain-side above the power-house site.

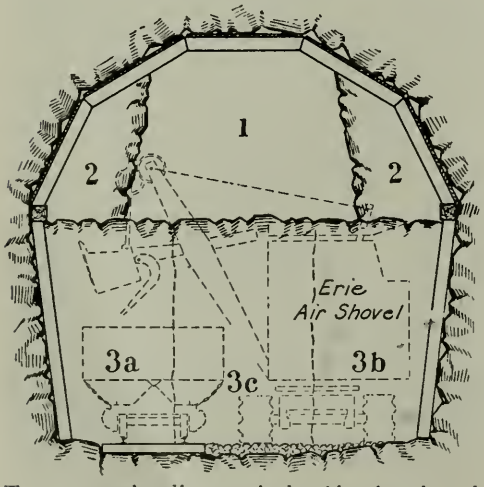
It was assumed that very little water would be found in the tunnel, its elevation above river level and its close proximity to the face of the canyon naturally affording good drainage, especially in such porous formations. Such proved to be the case. We knew that we would encounter three characteristic volcanic formations, (1) tuff or volcanic ash, (2) agglomerate, lava mud and angular rock, and (3) lava rock. Any one of these in a fairly solid state or fractured and broken. These formations changed in rapid succession in the course of the tunnel, several changes frequently occurring in a heading within a distance of a few hundred feet.

Practically the entire tunnel was timbered. Over the timbers lagging boards two or three inches in thickness and about five feet in length were driven. Behind the lagging all cavities, sometimes of considerable height, were filled with slabs, the barky part of logs, and sometimes, also, with cordwood and scrap lumber. This

timber will play no part whatever in the permanent construction of the tunnel lining. It is used only to hold the ground and to protect workmen against falling rock. The permanent reinforced concrete tube to be built entirely inside this wood timbering will be strong enough with its 5,000 tons of steel to withstand the full internal water pressure without support from the mountain above, and sufficiently thick and arched to resist each pressure from without. This concrete lining will be placed by the use of steel collapsible forms moving on big jumbos or carriers, the concrete to fill the forms being supplied by concrete guns.

The tunnel was driven with the top heading in advance and the bench following at a distance of thirty to one hundred feet or more. Two methods were used in advancing the top heading, one with a top center drift employed where the ground permitted, and the second with wall plate drifts utilized in very loose formations. With both systems of driving it was necessary on account of loose formations to keep the timber lining close to the excavated face, five feet usually being the maximum advance of boring ahead of timbers even in the drifts. Thus we had three operations going on in rapid succession, drilling and shooting, mucking and timbering.

Our first boring operations were carried on with eight miners and nine muckers under a shift boss working in the top heading or headings, and three miners and six



Top center heading method. Air shovel and cars employed for mucking. Used in solid or tight formations

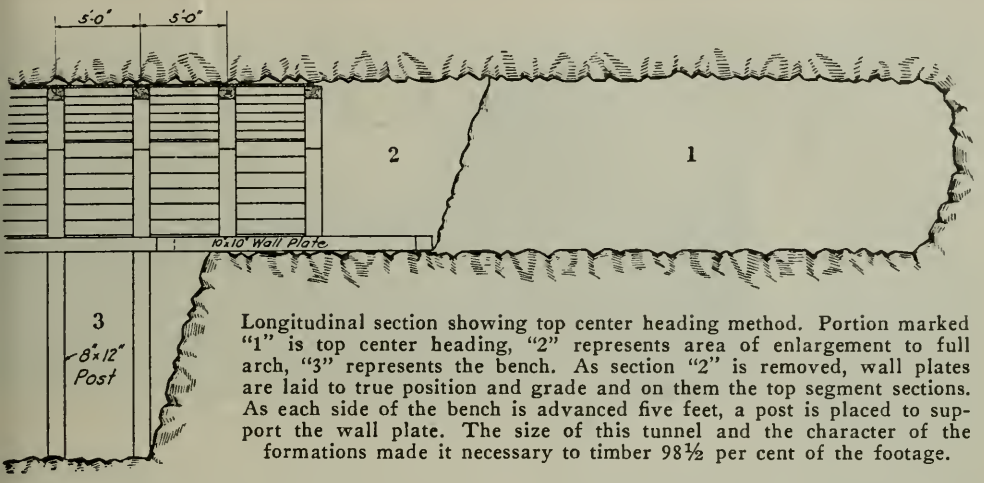


Tunnel mucker used in the work

muckers at the bench under a second shift boss. Since the most continuous and the heaviest work was performed by the muckers of the bench, and since the speed with which the bench could be mucked was the limiting element in our tunnel progress, we were most desirous of replacing these muckers with a mechanical excavator. The ordinary steam shovel using compressed air instead of steam as source of power was unsuitable on account of the large expense of the crew and trackmen required for operation and the working space such a large shovel would occupy.

At this time there was developed by one of the steam shovel companies an air operated shovel of the full swing or merry-go-round type, mounted on crawlers or caterpillars. This shovel, with boiler and fuel tank replaced by cast iron counterweights mounted on the rear of the frame, had the advantage of extreme compactness, its overall length being only eighteen feet. These counter-weights act also as "armor," which makes it unnecessary for the shovel to move far back from the face during the shooting. The shovel is turned with this armored rear end toward the heading and moved back only ten to twenty feet from the face of the bench.

Four of these shovels were purchased, and after modifications quickly made in the field were put to work in the longer headings, Nos. 1, 2, 5 and 6. With their installation specially low-built six-yard capacity side dump cars hauled by seven-ton storage battery locomotives were put into service, two of these cars making the usual train for a locomotive.



Longitudinal section showing top center heading method. Portion marked "1" is top center heading, "2" represents area of enlargement to full arch, "3" represents the bench. As section "2" is removed, wall plates are laid to true position and grade and on them the top segment sections. As each side of the bench is advanced five feet, a post is placed to support the wall plate. The size of this tunnel and the character of the formations made it necessary to timber 98½ per cent of the footage.

Prior to the use of the shovels muck from the top heading was taken in wheelbarrows from the top of the bench out over runways suspended from the roof of the tunnel. These wheelbarrows, in turn, were emptied directly into cars. When the shovels were installed these suspended runways were eliminated, the wheelbarrows being discharged directly over the edge of the bench to the main tunnel floor. Each shovel with its single operator not only replaced six hand muckers at the floor of the tunnel, at a saving of $1,500 per month at each heading, but, in addition, it handled all the muck from the top heading. Furthermore it loaded muck into cars from twenty to thirty feet of the entire tunnel bore every 24 hours as compared with ten to fifteen feet maximum which hand muckers could shovel from the bench alone.

Thus, the mucking of the bench no longer remained the limiting feature of



Power house site. On the opposite hill are seen the tunnel portal and surge-chamber. In the foreground piles of sand and rock for concreting

speed in boring the tunnel. Instead, the speed became dependent mainly on the advance of the top heading.



Clubhouse and dormitory at Pit 3 power house

To further increase the speed of tunnel driving, particularly at the top heading, and to recompense the crews for their extra effort, a bonus system was made effective on March 26th last. For the two headings mucked by hand, Nos. 3 and 4, the bonus crew consisted of eleven miners, fifteen muckers and two shift bosses. In headings where a power shovel was used the bonus crew consisted of twelve miners, eight muckers and two shift bosses.

The bonus was paid bi-monthly on the basis of ten per cent of each man's pay for each average foot of progress in excess of the base rate, eleven feet per day being required where a shovel was used and ten feet where all mucking was done by hand. For example, if the average daily progress in one of the headings where a shovel was used was fourteen feet in a bi-monthly period, each man's bonus was 30 per cent of his regular pay. A considerable sum in bonuses was paid during the eight and one-half months the plan was in effect.

In the month of August the crews at heading No. 1 established a world's record in the driving of a large timbered tunnel, their advance for the month being six hundred feet. The high average speed maintained made it possible to complete all driving two months ahead of schedule. Toward the end of the driving four of the heading crews, Nos. 1 and 2 versus Nos. 5 and 6, entered into an exciting contest. Headings No. 1 and 2 were nine hundred feet apart on November 1, while headings No. 5 and 6 were eleven hundred feet apart. As a result of unusual speed at heading No. 6 and misfortune in striking wet ground by No. 1 crew, the contest ended in favor of crews No. 5 and 6. They holed through at noon of December 3, 41½ hours before their competitors.



Steel frame of Pit 3 power house

Not only was the tunnel driven at high speed, bringing it to completion two months ahead of time, but it was bored within very favorable limits of cost. The total cost of the tunnel bore, including all overhead, was substantially less than the engineer's estimate. It is gratifying to the company to be able to announce that this tunnel was driven without a single fatality.

Development of a Great Gas Plant — the Potrero, San Francisco

By HARRY J. SMITH
Engineer of Construction, Department of Gas Construction and Operation

The past year was one of unusual constructional activity in the gas department. Not only were extensions and improvements of gas distributing systems made everywhere but important additions to generating equipment were made at most of our company's gas plants, notably at pivotal points, such as San Francisco, Oakland, Sacramento, San Jose, Fresno, San Rafael and Marysville. All of these improvements involved considerable expenditure but they were made necessary by the constant growth of population as well as of industry all over our "Pacific Service" territory.

The most important point involved, naturally, was San Francisco, where our gas plant at the Potrero has risen, during a period of fifty-four years, from a daily rated capacity of 500,000 cubic feet to one of 30,000,000 cubic feet. During the past year two new oil gas generators were installed there of an aggregate capacity of 10,000,000 cubic feet and the construction program for the present year includes the installation of two additional generators of similar capacity.

Our San Francisco gas generating and distributing system comprises another and smaller plant, namely, the Metropolitan, with a capacity of 6,000,000 cubic feet daily. From this combined service there was manufactured and distributed during 1924 a total of 8,547,047,000 cubic feet of gas and the peak day send-out was on December 19th last when 34,565,000 cubic feet of gas was sent out through the mains.

The great plant at the Potrero is situated at the foot of Humboldt Street, on the water's edge of San Francisco bay, and covers an area of eleven acres. The first plant at this location was built in the year 1870, when gas was generated entirely from coal. That plant consisted of thirty-six coal benches, six retorts to the bench, with, as before stated, a daily rated capacity of 500,000 cubic feet which, no doubt, was considered of considerable magnitude at that time. It was not long, however, before the demand for gas as a commodity began to increase. In the year 1885 it was found necessary to add eighteen coal benches to the Potrero plant, which increased its capacity to 800,000 cubic feet. In the year 1888 two gas machines of a new design called Springer gas machines were installed. These machines generated gas from coal and crude oil and marked the time when crude oil was first used in the generation of gas. Undoubtedly, this company was one of the first to take advantage of the new fuel. The adventure proved a success, for in the year 1902 two additional Springer gas machines were installed. Each of these had a daily capacity of 1,000,000 cubic feet, giving the plant an aggregate daily output of 4,300,000 cubic feet, and it was at this time



Starting the first oil-gas generating installation at the Potrero, 1906

that the original thirty-six coal benches were taken out of service, giving way to the new method.

In 1904 the Independent gas plant was purchased and became from that time on a unit of the Potrero gas plant, as it was located in the same vicinity. This plant, when purchased, had two nine-foot water gas generators, using coal imported from Wales and Australia for generator fuel. In the year 1905 four new generators of the same design were installed, giving the Independent plant a total capacity of 6,000,000 cubic feet, or a total for the entire Potrero plant of 10,300,000 cubic feet per day.

From this date on new developments were more rapid. In the month of February, 1906, an all oil-gas generator was installed. This generator had two shells, each sixteen feet in diameter, one a primary and the other a secondary, connected at the bottom with a throat section so that the gas generated in the primary shell passed through to the secondary and from there to the washbox. This new design of generator had a capacity of 3,000,000 cubic feet per day, and it was such a success that a second generator was installed in the month of February, 1907, giving the plant an output of 12,000,000 cubic feet daily, including the Independent. At this time the coal benches and gas machines that had been installed in 1885 and 1888 were eliminated from service to again give way to a more modern method.

In the same year the fuel supply for the Independent gas plant was changed from coal to lampblack. Lampblack is a by-product of oil-gas generation, and by using it as fuel our company found a means to dispose of it.

During the year 1908 it was found necessary to install two additional sixteen-foot diameter oil gas generators to take care of the increased demand, and with this added equipment the plant was capable of generating 15,000,000 cubic feet per day. Again taking a step forward, in the year 1915 two improved oil-gas generators, a

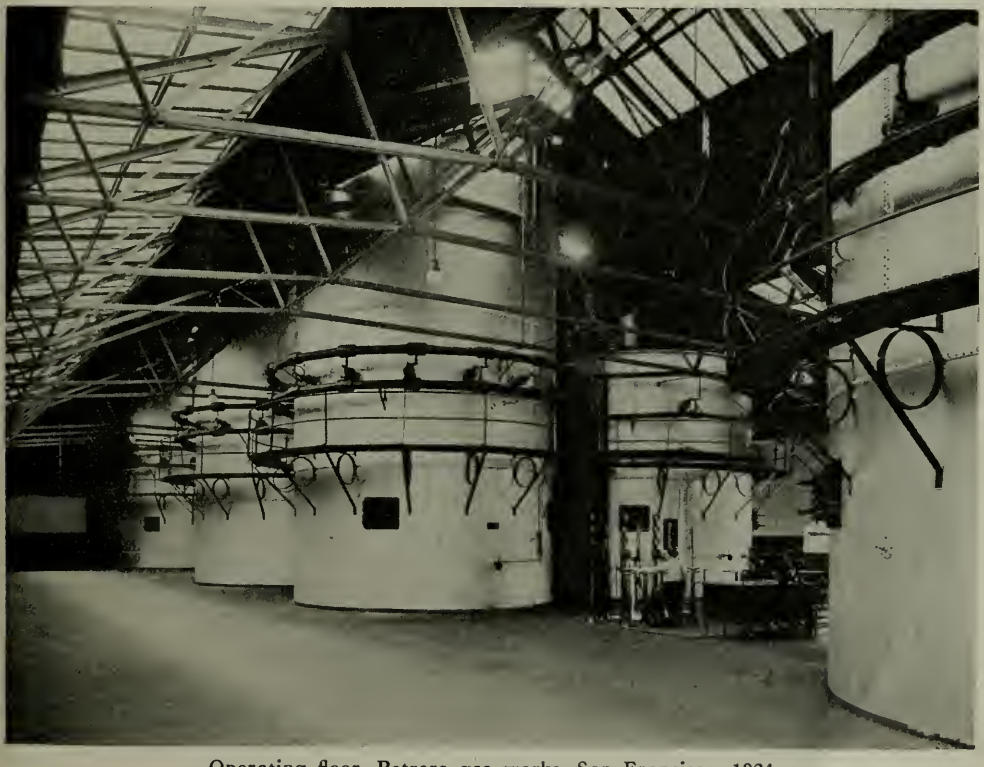


The late Mr. John A. Britton starting the first installation of the improved oil-gas generating process at the Potrero plant, 1915

newly patented process, were installed. These were also of the two-shell type and had a diameter of eighteen feet nine inches. The operation of these machines was entirely different from the sixteen-foot generators, as in the latter the main valves were hand-operated and required two men to open them, whereas in the improved oil-gas process these main valves were operated hydraulically and required but one man for operation. From the picture you can get an idea of the method of control as well as an inside view of these generators, which are operated on a heat and make cycle, approximately four runs per hour. These generators each had a daily capacity of 5,000,000 cubic feet and at this date (1915) gave the plant a total capacity of 22,000,000 cubic feet. The Independent water-gas generators were then shut down and their operation discontinued.

Due to the improved efficiency accomplished with these generators, two more improved sets were installed during the months of December, 1918, and January, 1919, respectively. In the year 1923 the two original oil-gas generators installed in 1906 and 1907 were abandoned to make room for two additional sets of the improved type which were placed in operation in the months of June and August of the year 1924. The oil-gas generators installed in 1908 were abandoned in 1924, so that the plant now has six of the improved oil gas generator sets in operation with a daily capacity of 30,000,000 cubic feet. Also, construction has been started on two additional sets, meaning at this date that the plant since its inception has used five different methods in the manufacture of gas, namely, coal benches, 1870 to 1907, coal and oil-gas machines, 1888 to 1907, water-gas generators, 1904 to 1915, oil-gas generators, 1906 to 1924, and improved oil-gas generators, 1915 to the present date.

In the early days coal was delivered by ship at the plant wharf, and bunkers, derricks and railways were necessary to facilitate the handling, but under the new method of generation the oil is pumped from the barge to storage tanks. In this way it is feasible to take oil as required,



Operating floor, Potrero gas works, San Francisco, 1924

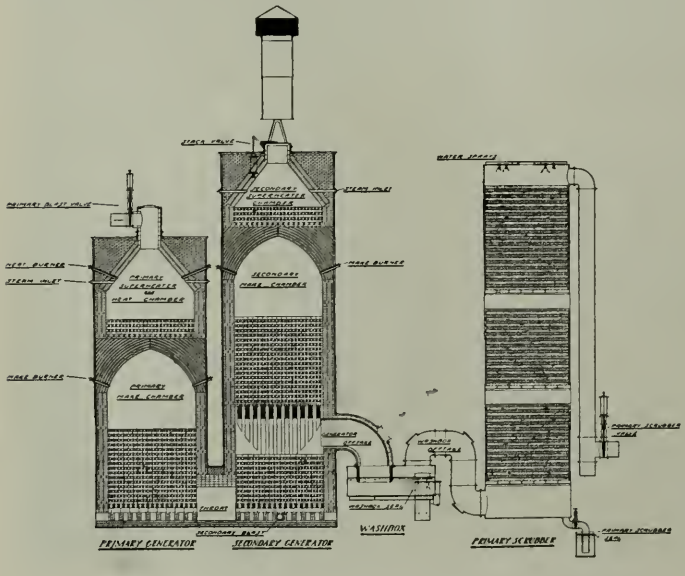
which is pumped through oil heaters to the generators at a temperature of 250 degrees Fahrenheit under 80 pounds per square inch gauge pressure. During the last two years two batteries of boilers, with a rating of 2,400 horsepower, of new design with double end firing, were installed. The fuel used for these boilers is lampblack, or carbon, which is a by-product from oil-gas generation and contains about fifty per cent of moisture. With the new design of boilers it is possible to obtain the full rating, whereas with the old design it is difficult to get a rating of even sixty per cent. With this installation the plant now has 6,000 boiler horsepower.



Scrubbers at the Potrero gas plant

In 1923 the company placed in operation a new design of gas purification known as the Koppers Company Liquid Purification Process, having a daily capacity of 24,000,000 cubic feet. In the following year the capacity was increased to 36,000,000 cubic feet per day.

In early days gas was delivered to the city under holder pressure of about one-quarter of a pound per square inch, and when the demand increased it was necessary to boost the pressure to reach some of the distant points. Later it was necessary to use compressors to raise the pressure up to thirty and one hundred pounds in order to supply the outlying sections. As these outlying sections grew, it was necessary to add compressors to supply the demand. At the present date the plant has four steam-driven and four motor-driven compressors. These compressors are of fifty and one hundred pound pressure and have a total capacity of 1,545,000 cubic feet per hour.



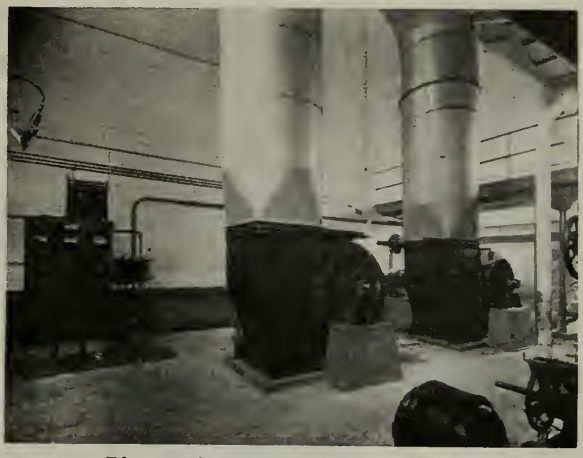
Cross-section of two-shell 18-ft. 9-in. improved oil-gas generator

Two of the steam compressors were placed in operation in the month of November, 1924, each having a capacity of 250,000 cubic feet per hour. These are of the Unaflow steam engine type, the first to be installed on this coast, and are the most modern type for compressor work. In this design the steam passes through the hollow cylinder heads on its way to the poppet

admission valves, and after cut-off and expansion have taken place the cool exhaust steam escapes through ports arranged about the middle of the cylinder.

This year we are installing two additional compressors, each having a capacity of 250,000 cubic feet per hour. One of these will be the Unaflow steam engine type, the other a synchronous motor-driven unit.

During the years 1923 and 1924 the company has installed two three-pound centrifugal gas compressors of the very latest type, each having a capacity of 1,500,000 cubic feet per hour. These are used to take care of the semi-high pressure trunk line and are driven by variable speed motors having a maximum speed of 3,600 revolutions per minute.



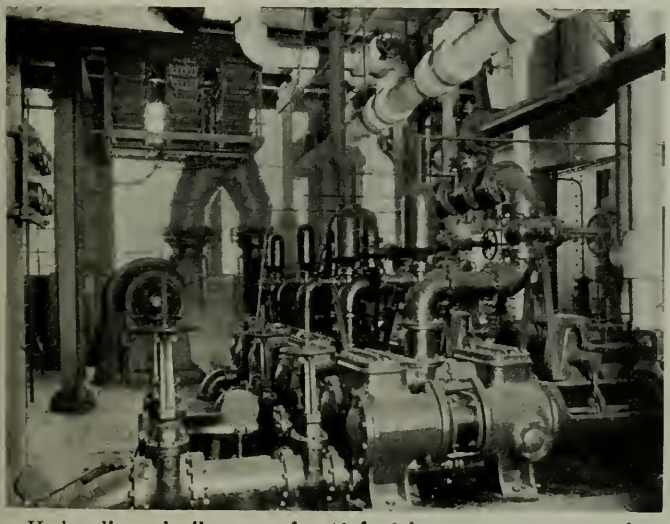
Blowers for liquid purification process

Other additions made to the plant in 1924 included secondary scrubbers, lampblack separators, electric substation, oxide purification and salt water system.

This year's program is a large one and includes Oliver-Borden filters, 2,400-horsepower in boilers, feedwater pumps, feedwater heaters, steam driven gas exhauster, electric driven gas exhauster, oxide purification, oil tanks, steam driven centrifugal compressor, station meters and other equipment necessary for gas manufacture. Our company has purchased twelve acres of land adjoining the Potrero plant so that future extensions can be made when required.

From the year 1906 to November, 1922, the Potrero plant supplied all of the Peninsula towns as far south as Palo Alto with high pressure gas through a four-inch pipe line to Redwood City and a two and one-half inch line to Palo Alto, a distance of approximately 31 miles. Between the years 1915 and 1918 the four-inch line to Redwood City was replaced with eight-inch and a four-inch pipe line was extended to Palo Alto.

All of the Peninsula towns south of Palo Alto were desirous of obtaining a supply of gas, so in the month of November, 1922, a four-inch pipe line was completed to Mayfield. In August, 1923, a six-inch line was extended to Mountain View; in February, 1924, an eight-inch line to Sunnyvale, and in the month of September last year, an eight-inch pipe line completed the final tie-in to the San Jose gas plant, a total distance between the two plants of approximately 50 miles. The Peninsula towns are now assured of continuous service as gas is supplied from both plants.



Hydraulic and oil pumps for 18-ft. 9-in. gas generator at the Potrero plant. Blowers in rear

Some Industrial Installations of Unusual Interest

Heating a Printing Shop with Warm Air Furnaces

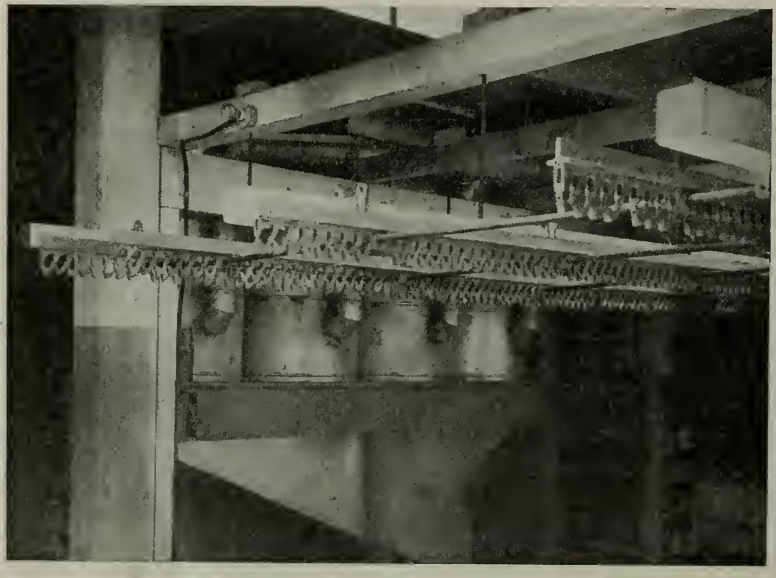
A gas heating installation of interest in a specialized field is that made by the Abbott Printing Company on the fifth floor of the Arts and Crafts Building at 500 Howard street, San Francisco.



View of printing shop, showing warm air ducts and outlets.

Many people do not know that the printing material is particularly susceptible to the influence of cold. The printers' ink used becomes thick and gummy in cold weather, with consequent smudging of paper. To offset this action some plants use perforated pipe gas burners over the press heads in proximity to the printed sheets. In the plant here described a more uniform heat is obtained by using a battery of warm air furnaces heated by gas.

The workshop measures 100 feet by 85, with 12-foot ceilings, having two-side exposure of one-half glass and six glass skylights in the ceiling, measuring six by eight feet. To heat this space, four warm-air furnaces using a maximum of 200 feet of gas per hour are necessary to maintain a temperature of 70 degrees. A rapid air circulation is induced through these furnaces by means of a No. 4 Sturdevant fan driven by a 2 horsepower motor which delivers 4,000 feet of air a minute.



Battery of warm air furnaces for heating the printing office.

A thermostat is used on this installation to maintain a temperature of 70 degrees maximum in the room. This temperature control is of great value because the ink is kept at a constant degree of consistency which naturally is reflected in the quality of printing. An economy of fuel is likewise produced by the action of this thermostat, which reduces the volume of gas to the required point.

Based on a yearly consumption basis, 600,000 cubic feet of gas will be used in this plant at a cost of $500. This will mean high quality of printing and comfortable, sanitary quarters for the employees. Such an expenditure can be capitalized to financial advantage by this progressive firm in excellence of product and increased volume of output due to the high condition of efficiency attained.

An Electric Brass Melting Furnace

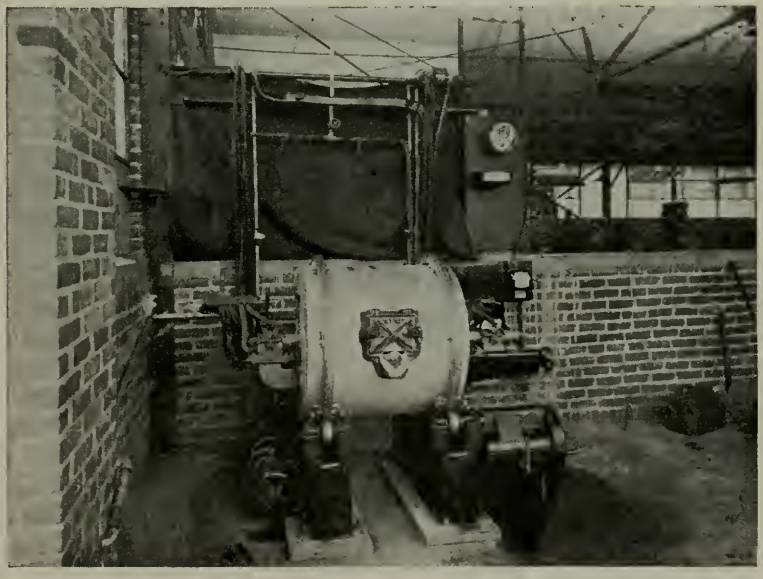
The New Business Department, Creative Electric Sales, San Francisco Division, reports the installation of a 60 kilowatt Detroit Electric Furnace Company furnace at the Market Street Railway Company's car shops, San Jose Avenue and Geneva Street.

This furnace, a Type L. F., has a capacity of from 200 to 250 pounds of metal per heat and is capable of producing from 2,000 to 4,000 pounds per day, with a consumption of 270 to 300 kilowatt hours per ton of metal melted. It is of the rocking type and is rotated or rocked by a ¼-horsepower motor, which is also used to pour the metal. This rocking enables the metal to absorb the heat from the lining, making it very efficient. There is practically no loss by radiation. The stirring action also prevents segregation, insures uniform analyses and prevents volatilization. The heat is generated by electrodes, which form an arc in the center of the furnace, out of contact with the metal. This results in low metal losses, usually less than 1 per cent, as compared to fuel-fired furnaces, where the metal losses run from 3 to 8 per cent.

The outstanding advantages of this type of electric furnace are as follows:

1. Complete control of physical and chemical qualities of alloy.
2. Insure about 99 per cent perfect castings —rejections almost negligible.
3. Cutting down of metal losses.
4. Speed of production.
5. Eliminate need of skilled melters.
6. Insure better working conditions due to absence of heat and objectionable gases.
7. Rate of production and quality of product not subject to barometric or temperature conditions.
8. Maximum lining life insured, since entire surface is washed by metal twice a minute.
9. Alloy can be changed with each heat if desired.

This installation is the first commercial electric brass melting furnace to be installed in California although they are used extensively throughout the Eastern States.



Type L. F., 200-lb., 60-kilowatt Detroit Electric Furnace

Dry Sterilization of Mattresses In the Interest of Public Health

By Thomas Telfer, New Business Department, San Francisco Division

In 1923 the California State Board of Health adopted regulations governing the sterilization of mattress and other like materials. In due course a San Francisco business man established a plant at 144 Russ St., San Francisco, known as the Central Sterilizing Plant. This plant is worked on a commercial basis and the business is limited almost entirely to fulfilling the sterilizing requirements on mattresses and pillows.

The particular section of the law governing mattresses and pillows requires a dry heat of 230 degrees Fahrenheit maintained for thirty minutes. To meet these conditions an oven was constructed to give an even heat throughout. A cold spot brought up to temperature would mean a resulting hot spot in another section with scorching effect upon the materials being sterilized. It was found that the average article would scorch at 275 degrees Fahrenheit. Some of the lighter and less expensive materials scorched at much lower temperature. The firing of the oven presented a variety of requirements to produce the necessary heat, quickly, accurately and evenly. The maximum burner capacity must give 230 degrees Fahrenheit within two or three minutes after a load has been placed in the oven, and yet have a minimum burner capacity small enough to just hold at 230 degrees Fahrenheit or drop a few degrees. To furnish an evenly heated atmosphere at all times a system of quick recirculation was necessary, and this also helped considerably in giving a fast temperature rise. A torch or carriage was essential to the operation as no loading could be done in direct contact with the heat of the room. The construction of the truck had to be such that it would be easily and quickly unloaded, reloaded and moved.



Exterior of the Central Sterilizing Plant

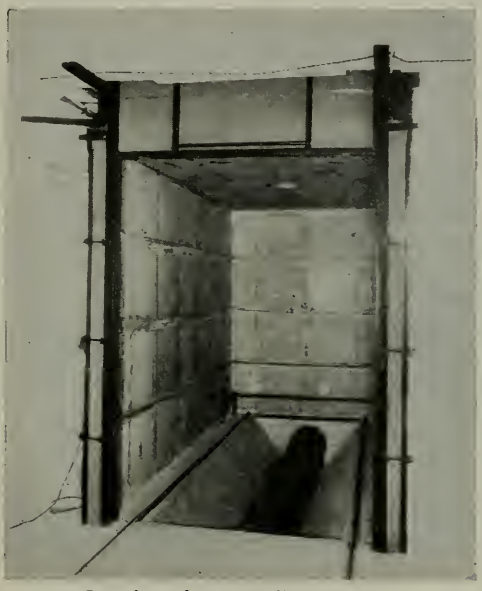
The oven was built in sections with tongue and groove joints, the walls being of heavy sheet metal filled with Sil-O-Cel C-3 powder. This construction gave a three-inch wall of insulated material. The sections were bound into a unit by angle iron corners and braces with longitudinal tie-rods belted tight. The inside dimensions of the oven are 6x13x8 feet. The roof sections were made to cap over the side walls, giving a tight seal on the top, while the base was sealed by grouting into a channel iron frame set in a groove in a concrete floor.

A counter-balanced door was provided of the same general construction as the walls of the oven, making up practically the full size of the front wall.

Surface combustion low pressure equipment is used for firing, with air at one pound from a positive pressure blower. The air from the oven is drawn into a fan blower and blown through a large pipe down into the combustion chamber. A single burner is used which fires through a tunnel directly into the combustion chamber and also into the path of the recirculating air from the oven. The heated air is blown from the combustion chamber into a large pipe which has two-inch perforations graduated to give a good distribution of

heat. This pipe lays on saddles in a recess two feet deep in the bottom of the oven. In this manner the heat travels directly up through the articles being sterilized without a spot heat at any point, and the air again travels around to enter through the combustion chamber. The recirculation blower has capacity for completely changing the air in the room twice in one minute. A vent with a variable opening leads from the recirculating pipe to eliminate disagreeable odors and products of combustion.

Charging is done by means of a truck constructed of channels and strap iron and running on wheels fitted with ball bearings for easy operation. To minimize the loss of heat from the oven during the charging operation the rear of the truck is fitted with a set of spring operated flaps bearing on the inside of the doorway when the truck is in the loading position, and completely closing the doorway. The position of the truck is controlled by blocks inside and outside the room. Tracks are set for running the truck in the correct position over the firing pipe inside the oven. Twelve mattresses may be sterilized in one load.



Interior of the Sterilizing Plant

Temperature control and automatic operations are provided by a thermostat operating in the air supply to the surface combustion inspirator, which with its one valve control and wide range of operation at a high efficiency adapts itself particularly to control of this type. The thermostat is specially built for a temperature range of 60 to 250 degrees Fahrenheit and operates in connection with Minneapolis control equipment to open or close a snap action valve on the main air line. The valve is by-passed to give the minimum capacity after the oven has come up to heat. Thus we have an oven that requires no attention after lighting and one that maintains the correct conditions for sterilizing. The capacity of the oven is 170 mattresses per day of eight hours. The amount of fuel per mattress is 15 cubic feet of gas, while the power for motors adds .2 K. W. to this figure. One man can operate one oven and run the plant.

Each mattress or pillow sterilized is tagged and stamped with the seal of the Central Sterilizing Plant. A number is assigned to each piece and a record kept as to date and dealer to prevent interchange of tags. The only plant equipment required besides the oven installation is a number of dolleys to handle about ten mattresses each, used for placing mattresses before and after sterilizing.

On an installation of this type gas is particularly adapted. It permits of direct firing with resulting economy. It is clean, a characteristic absolutely essential in sterilizing. It allows of easy and accurate control, a merit desirable both in fuel economy and ease of operation.

The Central Sterilizing Plant in operation today is performing a service for the public health in helping prevent the spread of disease through negligence and carelessness. In the city in which it is operating the public need no longer buy a rebuilt mattress with any concern as to where the materials had their origin. One can demand a sterilized mattress or pillow and be assured of its condition by the tag and seal of the plant. It has been determined that aside from the health standpoint the sterilizing has a marked beneficial effect in producing a new life and lightness in the mattress and pillow materials which makes the article a better seller for the dealer to handle.

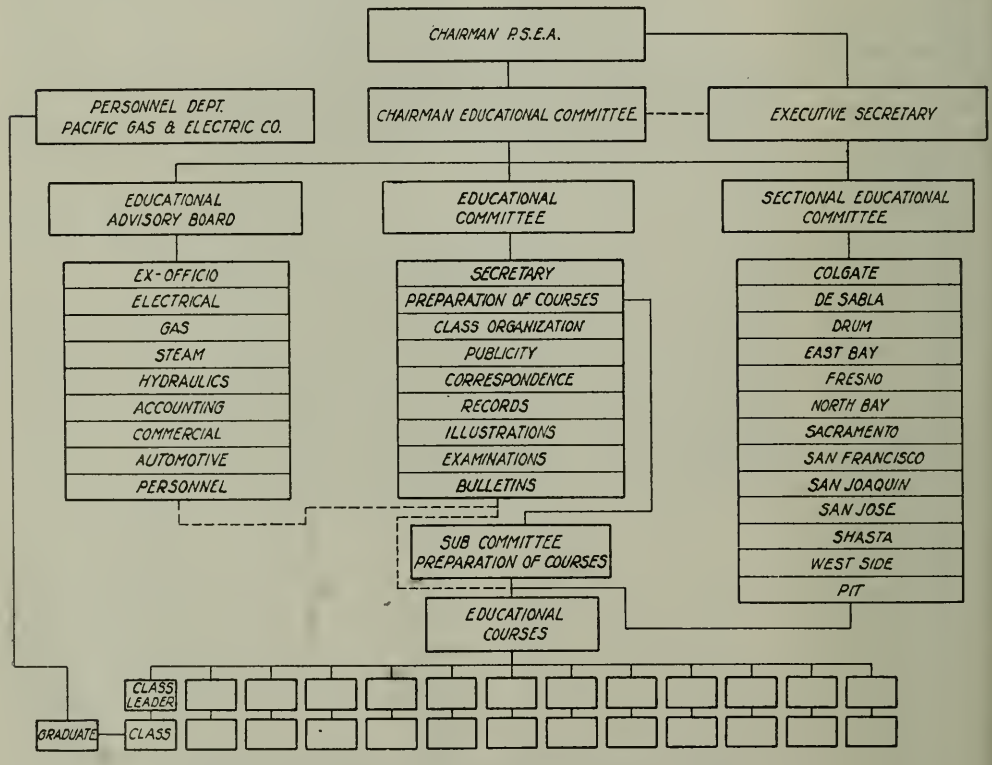
This installation marks a new industry aided by "Pacific Service."

Company Employees Prosecute Valuable Educational Work

Our Pacific Service Employees' Association is making marked progress in the educational branch of its varied activities. There are now eleven educational courses, with 756 students enrolled. Upon the completion of his course to the satisfaction of the Educational Committee the student is given a certificate and his name sent to the Personnel Department for recordation. Up to the present date 511 certificates have been issued.

This educational work dates from 1917, when the P. S. E. A. urged its members to take advantage of a series of lectures given by the department heads of our company in electrical and gas engineering, finance and accounting. These lectures opened in San Francisco and were accompanied by illustrations and practical demonstrations; and they became so popular that they extended further into "Pacific Service" territory. Then began educational visits to the various company plants under the supervision of competent guides, and a question box was established with qualified technical advisers in the various special subjects.

Up to 1921 the educational activities of our Association were in process of development and in August of that year a Director of Education was appointed to function in co-operation with an Advisory Board. This Board was selected with the idea of getting the best talent our company afforded in each particular phase of its activities and of developing a series of educational courses. In the month of January, 1922, the educational work was opened along definite lines, with courses written by employees of the company and published by the Association. Six courses were written covering,



Pacific Service Employees' Association Educational Chart, 1925

respectively, direct current electricity, commercial electricity, gas production, elementary hydraulics, steam boilers and steam engines and turbines. During the years 1923 and 1924 five additional courses were prepared on the subjects of algebra, gas transmission and distribution, arithmetic,. alternating current electricity and naturalization. Several new courses are now in course of preparation, these upon the subjects of trigonometry, geometry, electric line construction, electric meters, business English, electric machinery, and accounting.

When an employee makes a request for enrollment in an educational course, the educational chairman of his particular geographical section endeavors to interest others in the same course, and when a group of four or five have signified their willingness a class leader is selected and the class started. The next step is to secure the courses for study, for which a deposit is required, but this is refunded to the student upon the successful completion of his course and the course itself becomes his personal property. It will be noted from the accompanying chart that the educational work is well organized.

The actual educational activities are handled by three committees, the Educational Committee, the Sectional Educational Committee and the Educational Advisory Board. The Educational Committee is organized to carry on all work covering preparation of courses, class organization, publicity, correspondence, records, bulletins and illustrations. The Sectional Educational Committee is made up of thirteen sectional educational chairmen, taken from the various company divisions, and it is their work to secure students for courses, select class leaders from classes and report each month to the Educational Committee the number of students enrolled and the progress made. The Educational Advisory Board consists of heads of departments in the various branches of the company and functions directly with the chairman of the Educational Committee in an advisory capacity.

The following constitute the working organization of the P. S. E. A. for the current year:

Officers—Chairman, W. D. Skinner, Oakland; Vice-Chairman, W. R. Baker, San Francisco; Secretary, Margaret Gray, San Francisco; Executive Secretary and Treasurer, J. C. Carmody, San Francisco; Assistant to Executive Secretary, Inezetta Holt, San Francisco; Attorney, R. W. DuVal, San Francisco; Auditor, H. T. Terry, San Francisco; Purchasing Agent, E. O'Mahoney, San Francisco.

Executive Committee—Van E. Britton, Oakland; R. A. Eddy, San Francisco; W. N. Munro, Oakland; H. J. Smith, San Francisco; W. F. Pape, Oakland; L. N. Sachs, San Francisco; J. M. Williams, San Francisco; C. Z. Yost, San Francisco; R. W. DuVal, (Ex-officio) San Francisco.

Members Employees' Welfare Committee—Pit Chapter, L. L. Daly, Pit No. 3, Burney; Northern Region, A. M. Carah, Chico; Central Region, W. E. Lininger, Auburn; Bay Region, A. J. Perry, Oakland.

Chairmen of Local Sections—Colgate, M. S. Mitrovitch, Marysville; De Sabla, O. P. Erdahl, Camp No. 1, De Sabla; Drum, E. G. Wilcoxon, Auburn; East Bay, R. Crowell, Oakland; Fresno, G. D. Cullen, Fresno; North Bay, W. E. Crain, San Rafael; Sacramento, G. E. Murphy, Sacramento; San Francisco, E. G. Campbell, San Francisco; San Joaquin, V. Handley, Modesto; San Jose, H. W. Schmidt, San Jose; Shasta, R. A. Jackson, Redding; West Side, W. S. Cluff, Red Bluff; Pit Chapter, R. D. Reeve, Burney.

Committee Chairmen—Policy, R. W. DuVal, San Francisco; Sectional Activities, W. R. Baker, San Francisco; Finance, H. W. Beekman, Oakland; Educational, Harry J. Smith, San Francisco; Benefit and Loan, Chairman, C. Z. Yost, San Francisco; Vice-Chairman, R. A. Eddy, San Francisco; Social Activities, Chairman, Van E. Britton, Oakland, Vice-Chairman, J. M. Williams, San Francisco; Publications, E. G. McCann, San Francisco; Membership, L. N. Sachs, San Francisco; Publicity, J. Chas. Jordan, San Francisco; Recreational Activities, B. N. Merritt. Oakland; Women's Affairs, Mrs. Mary Jackson, San Francisco; Reception, W. N. Munro, Oakland; Editorial, F. S. Myrtle, San Francisco; Property, Chairman, J. M. Williams, San Francisco; Vice-Chairman, V. Frederickson, Oakland; Athletic, W. F. Pape, Oakland.

The Financial Side of "Pacific Service"

A WORD OF CAUTION TO OUR STOCKHOLDERS

A number of instances have come to our attention of stockholders being approached by salesmen who have endeavored to persuade them to sell their Pacific Gas and Electric Company stock and purchase other securities. The following item clipped from the San Jose Mercury Herald of January 5, 1925, tells of a particularly aggravated case of this kind where an aged man, apparently in limited financial circumstances, had been induced to part with $2,000 worth of this Company's stock and to purchase a security which proved to be valueless, the incident preying upon his mind to such an extent that he committed suicide.

Stock Transaction Is Suicide Cause

Thought to have been brooding over a stock transaction which had caused an alleged loss of about $2,000, Pat Ryan, aged about 65 years, yesterday took his own life by hanging himself from a transom of his cabin home at 831 Willis avenue.

Detectives John Guerin and Thos. Short answered the call of Mose Vandermulla, a friend, who found the body, and in turn called Coroner Amos O. Williams, who took charge of the body and will conduct an investigation.

The officers found a note which read: "Please bury me decently. The key is to a safe deposit box at the Garden City Bank. Good Bye, Pat Ryan."

According to Vandermulla, who resides at 731 Martin avenue, he has known Ryan for a long time and says he leaves a wife and two sons at Sisson, Cal. On December 23, 1924, according to Vandermulla, two men induced Ryan to transfer P. G. & E. stock of the value of $2,000 for stock in another company which Ryan told Vandermulla afterward had proved to be about worthless. Since this transaction Ryan has been brooding over his loss, according to his friend. Vandermulla was with Ryan until a late hour Saturday evening.

A large number of this company's 30,000 stockholders, fortunately, are experienced investors who will pay but little attention to the efforts of the salesmen of questionable securities to trade them out of their holdings of Pacific Gas and Electric Company issues. There are, however undoubtedly many others who are not yet sufficiently versed in the art of investment to discriminate readily between high grade securities and those of doubtful value. In the hope, therefore, that a word of caution on this subject may be productive of some good, we are setting forth below some of the principal points which should be considered by every individual who contemplates the purchase of stock. It should not be difficult to subject to any security under consideration these elementary tests, which we have here applied as briefly as possible to Pacific Gas and Electric Company issues.

(1) *Is the industry well established (that is, safely past the experimental stage) and showing a healthy growth?*

Pacific Gas and Electric Company, or its predecessors in title, has been in continuous operation for more than 70 years. Its business has increased steadily year by year until it is now one of the largest and strongest companies of its kind in the United States.

(2) *Is the investment backed by actual physical property sufficient to justify the company's capitalization?*

The present value of this company's physical properties is many millions of dollars in excess of the entire face amount of the bonds and stock outstanding with the public.

(3) *Has the security paid interest or dividends consistently over a period of years, and is it now yielding a satisfactory return rather than carrying an indefinite promise of profit at some time in the future?*

Pacific Gas and Electric Preferred Stock has paid dividends of $1.50 per share quarterly, or at the rate of 6 per cent per annum, since 1909. Thirty-six quarterly cash dividends have been paid on Common Stock, the present rate being $2.00 per share quarterly, or 8 per cent per annum.

(4) *Is the business stable in character, dealing in commodities for which there is at all times a ready market?*

Pacific Gas and Electric Company furnishes services of an essential nature, being engaged in the sale of electricity, gas, water and steam, and, in a minor degree, in supplying street railway and telephone service. At November 30, 1924, 760,456 customers were connected to the company's distribution system.

(5) *Is the territory in which the company operates progressive, presenting favorable opportunities for future development?*

Northern and Central California is one of the most prosperous and rapidly growing sections of the entire country. The Pacific Gas and Electric company's lines, which serve this section, extend into 38 counties having an area of 59,000 square miles, and a population of over 2,200,000. The extent of this territory and the highly diversified sources of the company's revenues impart an unusual stability to its business.

(6) *Does there exist an active market for the security, so that stockholders may sell their holdings at any time if occasion requires?*

Pacific Gas and Electric Company Common Stock is listed on the New York Stock Exchange. Both the Preferred and Common Stocks are also listed and actively dealt in on the San Francisco Stock and Bond Exchange and in other financial centers, and may be bought or sold at all times through any reputable broker in the United States.

(7) *Has the business a sufficient working capital to meet any contingencies which may arise, even in those periods of industrial depression which inevitably occur from time to time?*

Pacific Gas and Electric Company uniformly follows the policy of maintaining an adequate working capital, cash on hand during the past three years having averaged $10,000,000. For many years the company has conducted its business on a cash basis without any floating debt.

(8) *Is the security of such character that your bank will accept it as collateral for loans?*

Banks will loan money upon any of the stocks or bonds of the Pacific Gas and Electric Company.

(9) *What is the character of the company's management and personnel?*

Pacific Gas and Electric Company is managed by men of long experience in utility matters, with a trained and efficient organization of 10,000 employees.

(10) *Is the enterprise of sufficient size to withstand the stress of active competition from other companies engaged in similar business?*

Pacific Gas and Electric Company does more than three-fourths of all of the gas and electric business in the territory in which it operates. Under the laws of the State of California no public utility can enter a field already served by an existing company provided the latter is giving adequate service at reasonable rates.

(11) *Is there any assurance that the money paid for the purchase of stock will actually be invested in the business instead of going into the pockets of promoters?*

No securities can be issued by the Pacific Gas and Electric Company without express authorization of the Railroad Commission of the State of California, and every dollar received by the Company from the sale of such securities is accounted for to the Commission.

(12) *Is complete information regarding the company's progress and operations available to stockholders?*

In addition to the reports required by law to be filed with the State Railroad Commission, the Pacific Gas and Electric Company makes every effort to keep its stockholders fully informed of its affairs through the medium of PACIFIC SERVICE MAGAZINE, which is sent without charge to any stockholder desirous of receiving it, and through the publication of quarterly earnings statements and other information. The company's annual report, which is also mailed to every stockholder, contains a most complete record of each year's operations, with comparative statistical tables showing as clearly and concisely as possible its progress from year to year.

The foregoing merely suggests a dozen of the things which should ordinarily be considered before making an investment in stocks or bonds. Other points will undoubtedly occur to our readers. We might add this general word of caution:

Don't allow your good judgment to be overcome by alluring promises of large profits and quick returns; and, if in doubt, consult your local banker.

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF
A. F. HOCKENBEAMER - BUSINESS MANAGER

Year's subscription - - - - - - $1.50
PACIFIC GAS AND ELECTRIC COMPANY
445 Sutter Street, San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL XVI JANUARY, 1925 No. 3

EDITORIAL

The year 1925 opens full of promise. Not alone in our favored Western land but throughout the country the signs in the sky portend progress and prosperity. There is a feeling of confidence abroad in the land, and that means much.

For the public utilities generally 1925 will be a year of unusual activity. Out here on the Pacific slope the gas and electric utilities, particularly, are called upon to put their shoulders to the wheel, so to speak, and go forward to meet the inevitable conditions resulting from a constantly increasing population and a marvelous speed of industrial activity in all directions.

How our company views the prospect may be gathered from the fact that our construction program for the year involves an expenditure of some $23,000,000 for extensions and improvements of both our gas and electric properties. On the electric side, our company's engineers are losing no time in the construction of Pit Three development; in fact, so remarkable has been the progress of this hydro-electric construction project that it is confidently anticipated that by July next Pit Three will be a completed development and, with it, the addition of, in round numbers, 107,000 horsepower in installed capacity to the Pit River branch of the "Pacific Service" electric generating and distributing system. Up in the Sierra Nevada, too, the work of increasing water storage and distribution facilities in our Spaulding-Drum system is progressing rapidly and it will not be many months before our electric consumers in the Sierra Nevada region and the fruit farmers in the valley below will derive the benefit of these improvements in some 25,000,000 additional kilowatt hours of electric energy and some 1,800 miners' inches of additional water for irrigation.

In the gas department the year that is past was the most active of its history and the year just entered upon bids fair to rival it. Millions of dollars are to be expended in new generating equipment and extensions of service facilities.

Our company means to maintain its pride of place as a broad, progressive public utility, owned, for the most part, by Californians and operated by Californians to serve California. It represents the best kind of public ownership. During the last ten years it has developed a non-political public ownership of its properties through the sale of its stocks to the public at large, and as a result today its properties are owned not by a small group but by a very large proportion of the people of Northern and Central California. To quote President Creed in a recent message issued to the people of San Francisco:

"We look forward to a time when every customer and citizen within our territory will be also a stockholder, for then both public and company will receive the full benefits of the kind of public ownership that promotes efficiency and develops constructive work for the Commonwealth."

It may not be generally known that in the twelve years between 1909 and 1921 California progressed from the position of sixteenth to that of the second richest agricultural State in the Union, being surpassed only by Texas. California advanced to her proud position during years when crop values were falling everywhere. And, she is marching on. Since 1921 she has been producing over thirty-five per cent of all the fruit grown in the United States and producing it far more cheaply than elsewhere. The California farmers' prosperity is solidly founded upon diversified crops, irrigation and co-operative marketing.

California is a great exporting State. Figures collected by the Department of Commerce show that during the first six months of 1924 she sold goods abroad to

the amount of $109,000,000, or about $40 per capita. These exports, with few exceptions, represented the products of her own soil and the outcome of her industrial development and not shipments of commodities grown or manufactured elsewhere.

For the fourth time in a period of thirteen years the National Electric Light Association will hold its annual convention on the Pacific Coast. Seattle was the favored spot in 1912, then came San Francisco in the year of her Panama-Pacific International Exposition in 1915; Pasadena had the convention in 1920 and now it is San Francisco's turn again.

Enormous changes have been wrought during the period mentioned. During the period from 1915 to 1920 the aggregate hydro-electric output of the California electric utilities increased from 1,815,900,000 to 2,568,541,000 kilowatt hours and the steam output from 414,900,000 kilowatt hours to 1,167,000,000. At the 1920 convention, however, the utilities were warned that they were in the neighborhood of 100,000 kilowatts of installed capacity short of what conditions called for, conditions that were attributable to a greater industrial activity, an enlargement of agricultural acreage and a more general use of electrical appliances. Owing to the greatly increased cost of fuels used in the production of power, it was decided that California's undeveloped hydro-electric power was the logical source of supply to meet the increasing needs; so, in response to this warning the companies got busy, with the result that at the time of writing there has been an increase of installed capacity of hydro-electric systems in California of 398,023 kilowatts over the 1920 aggregate and to this figure must be added an amount of, approximately, 226,000 kilowatts representing large installations in process of construction and whose completion may be looked for by next summer.

San Francisco is already preparing to give royal welcome to the men of the N. E. L. A. It is anticipated that the attendance from points east of the Rockies will be fully 2,500. The convention will be held during the week of June 15th and the various convention committees are already organized and at work. Arrangements are now in progress for a series of inspection trips through which we expect to afford our Eastern visitors an opportunity to note for themselves what we in our Western land have done, are doing and expect to do.

With deep regret we record the passing of Mr. Leroy Moore, Assistant Treasurer of the company, who died suddenly December 30th last at his home in Berkeley, aged 74 years.



LEROY MOORE

Mr. Moore was born at Sarona, New York, June 25, 1850. After receiving his education he went to Michigan, where he engaged in lumber and banking, during the period from 1870 to 1890. Subsequent to that he went to Georgia where he took up mining interests. After six years he returned to Michigan and from 1896 to 1897 he was manager of the Mutual Life Insurance Company at Grand Rapids. He came to California in 1897 and the following year made his entrance in public service as an employee of the Yuba Electric Company at Marysville. In due course, this company became a part of the Pacific Gas & Electric Company's system. In 1921, upon the death of Mr. Joseph C. Love, Mr. Moore was made Assistant Treasurer and served in that capacity until his death.

Mr. Moore was universally respected. There are notable incidents of his career which show him to have been a man of very high principle. A widow and two sons mourn his loss, and to them "Pacific Service" extends heartfelt sympathy.

Resolutions of respect to the memory of the late Mr. J. W. Hall, who for many years was in the employ of our company as manager of the Stockton Water District, were adopted by California Section of the American Water Works Association at its recent convention in Sacramento.

Mr. Hall was an active member of the Association from 1907 to the date of his death, March 10th, 1924.

In the Path of State Development

Yuba and Sutter counties are destined to contribute largely to the sugar beet industry of California because soil and climatic conditions are ideal for the raising of this product.

The experimental stage is a thing of the past. There is no longer any doubt and land owners are beginning to take note that here is a product from which good returns may be reaped annually.

Many farmers have announced a decision this year to plant some of their land to sugar beets. An increased acreage will be planted in the Sutter basin where the Alameda Sugar Company has secured 4,000 acres of land for this purpose.

Enough tonnage has been signed up in the immediate counties to guarantee the reopening of the sugar plant at Hamilton City this coming season.

There is no fear of over-production as this country imports an enormous amount of sugar to meet demands. Foreign countries may produce on a large scale and yet not affect conditions here because the United States is not an exporter of sugar.

One hundred thousand tons of canning cling peaches and the distribution of approximately $5,000,000 among the growers of Yuba, Sutter and Butte Counties is predicted for this year. This is on a basis price of $50.00 a ton.

With normal climatic conditions prevailing throughout the district and with new peach trees coming into bearing in the three counties, County Horticultural Commissioner Harry P. Stabler of Sutter County can see no failure in securing the amount in tonnage for the fruit season of 1925.

Yuba County will, with its 1,100 newly planted acres of cling peach trees coming into bearing this year, together with the 1,000 acres already producing, have for its share about 8,000 tons; Sutter County is confidently expected to produce at least 90,000 tons of peaches and Butte nearly 2,000 tons.

A noteworthy addition to the Oakland manufacturing section is that of the Chicago Lumber Company of Washington, marketing California white and sugar pine lumber and products. Shipments in the rough, in the plank, or worked according to customers' specifications, are being shipped from the Oakland plant to all points in the United States. Mr. L. V. Graham, Vice-President and General Manager, states that they carry a large stock of several million feet of lumber. A fully equipped mill of the latest type of electric driven wood working machinery, totalling 600 horsepower, insures rapid production of quality products.

The Illinois Wire and Cable Company, one of the old line manufacturers in this specialty, has completed construction of its Oakland plant, and production is now under way. Oakland's strategic position for distributing factory products to the Western States and, particularly, the Pacific Coast, is again recognized.

"Pacific Service" will provide electrical energy for the operation of the new Oakland-Alameda estuary tube. Construction of the tube will require two years' time and when completed will permit unobstructed navigation of the Oakland estuary for a distance of four and one-half miles.

The past year in the foothill section of Yuba county insofar as mining activities are concerned witnessed several marked advances. Especially is this so of the territory adjacent to Smartsville and Timbuctoo, both communities dating back to the days of gold's flow in 1849.

Along the north San Juan ridge many mines have been operated, some reopened and others just prospected. Farther to the north, along the Yuba river, there has been erected a large power dam, that of Bullards Bar, at a cost of approximately $1,500,000. Hydraulic mines have been given new impetus because of the restraining effects of this dam, and mines which for many years have lain idle are to be worked to a more or less degree of full capacity.

Scattered here and there over the county's entirety can be found the miner, with sunken shaft or tunneled prospect, digging deeper and deeper for the metal which cheers. Everywhere there is the spirit of hope being displayed, each and every one of the interested believing that the season of 1925, with an abundance of water available, will prove to be the best in the county's history. Such has been the thought throughout 1924 and its continuance is looked for, with an unsurpassed flow of gold throughout the coming year.

Hubbard & Company of Pittsburg Pennsylvania, manufacturers of Pierce electrical line hardware, announce a branch production plant for Emeryville. The first unit will involve a capital investment in excess of $250,000 and will employ 125 men.

Rapid progress is being made with the construction of the new refinery for the California Salt Company near Alvarado. This plant, when in operation, will require 700 horsepower in electric motor driven machinery, the electrical energy for which will be supplied by "Pacific Service."

Coincident with the production of copper rods and wire at the Pittsburg plant of the Columbia Steel Corporation is the coming of the California Wire & Cable Company to an adjoining five acre tract. All varieties of insulated copper wire will be manufactured from the company's new Pittsburg plant. A separate department will produce lead covered cable. The California Wire & Cable Company now operates a plant at Orange, California.

Probably the most outstanding example of undiminished prosperity in view of an unprecedented dry year is the Patterson Colony, comprising 17,000 acres of irrigated land lying in the northwestern corner of Stanislaus county along the fertile river plains of the San Joaquin. The following interesting figures are obtained for the year 1924 from a census taken by the Patterson Chamber of Commerce co-operating with the Patterson Water company:

Alfalfa, 10,200 acres; grapes, 450 acres; beans, 280 acres; grains, 3,220 acres; corn, 238 acres; vegetables, 200 acres; prunes, 110 acres; peaches (one-half bearing, 880 acres; apricots (one-third bearing), 520 acres; pears, 15 acres.

There were shipped out by railroad this year 77 cars of peaches, 7 cars of apricots, 12 cars of winegrapes, 1 car of dried peaches and 1 car of dried apricots. In addition to railroad shipments, approximately the same tonnage was shipped by truck.

Patterson recently held a water carnival to celebrate the fact that the Patterson Water Company had furnished uncurtailed irrigation up to October 10th in face of the fact that many of the other irrigation projects had long since ceased to function. Water for the Patterson colony is pumped from the San Joaquin river at a point where it is possible to utilize the augmented flow caused by the drainage from the systems farther up the stream, thus receiving double assurance of an adequate service.

The system's pumping plants are supplied with 2,300 horsepower of "Pacific Service" over the Modesto-Patterson 60 KV line.

In a recent issue of the *Holstein-Friesian World,* the unofficial organ of the Holstein-Friesian Association of America, a list of the names and records of the sixty highest milk producers on official one-year tests of Holstein-Friesian cattle in the United States and Canada is given, and it discloses the fact that Colusa county holds the distinction of having the only herd in the United States or Canada that has developed two cows of over 30,000 pounds of milk production in one year within the first thirty-six animals of highest producers of the breed. This list is dated August 24, 1924, and is strictly official.

It requires no stretch of the imagination to realize that Colusa County contains all the elements needed to make ideal dairy conditions and it is safe to assume that if the conditions were otherwise this wonderful showing on the part of the J. S. Gibson Company would not be possible.

The River Farms Company of Knights Landing sold 170,000 sacks of barley for export to London for approximately $500-000. According to E. L. Dow of San Francisco, president of the company, the sale price was $3.00 per hundred, f. o. b. Port

Costa. This is equivalent to $2.85 at the ranch. The barley was of a fine brewing grade.

The River Farms Company had between 10,000 and 12,000 acres in wheat and barley, 8,000 acres in rice and 1,300 acres in fruit.

The Pacific Gas & Electric Company plays a very important part in this record production, in that it supplies the power for all the River Farms Company's irrigation.

A remarkable development is noticeable throughout Lake county. The town of Upper Lake, which was nearly wiped out by fire a few months ago, is fast being rebuilt. Concrete and fireproof buildings are taking the place of the old wooden structures.

Electric power lines are gradually being extended into the rural districts to serve not only lighting and agricultural power loads, but in many cases modern electric ranges, water heaters and air heaters are being used.

In the town of Kelsyville a new high school is being built which will be modern and up-to-date in every respect. An electric heating system will be installed with a connected load of 96 kilowatts.

With the sale of the old Phelps Estate near San Carlos for $750,000 one of the largest real estate transactions in this state during the past year has been closed.

The large estate, consisting of 1,426 acres, has been sold to the Municipal Properties Company of San Francisco, and it is stated that improvements to the extent of $1,000,000 will be started immediately.

Improvement plans of the company, which are backed by Eastern and San Francisco capital, include the subdivision of the big estate, construction of streets, etc., and the laying out of a golf course, tennis courts, swimming pools, parks and several small estates.

Devonshire Estates will be the new name of the tract, suggested by the fact that the property is almost entirely forested with English oaks and, also, by the large size of the individual holdings.

It is reported that the El Solyo Ranch Company will improve and subdivide 1,700 acres of its holdings lying north of Westley between the highway and the river. The company plans to subsoil and level the entire tract, subdividing into units of 250 acres which will be improved to suit the purchaser. The El Solyo holdings also comprise an extensive irrigation system which is at present used in the development of a 534 acre peach orchard and a 300 acre Thompson seedless vineyard. Water is pumped from the San Joaquin river through a 250 horsepower plant on "Pacific Service."

The El Solyo project completes a block of 20,000 acres lying between Westley and Tracy which will, in the course of a few years, be put entirely under irrigation.

The new water system of Pine Crest has recently been completed at a cost of approximately $10,000. Pine Crest, located about 30 miles above Sonora, has rapidly become one of the most popular summer home sites in the North San Joaquin Valley. Upon the initiative of the one hundred property owners around the lake the system has been completed and paid for by a levy of $100.00 upon each holder. The entire installation consists of 10,000 feet of 3 inch and 2,000 feet of 1½ inch redwood stave pipe connected with two 10,000 gallon redwood tanks. Water will be supplied by a large spring.

Pine Crest stands today as one of the incidental by-products of a hydro-electric development program. Ten years ago engineers threw a rock-filled dam across the north fork of the Stanislaus and formed Lake Strawberry, incidentally combining accessibility of the artificial with the rugged beauty of the natural.

"Pacific Service" is keenly interested in the growth of Northern California and is actively engaged in furthering industrial development which comes within "Pacific Service" territory by its hearty co-operation in meeting the demands of its customers and by continually adding to and improving its service facilities.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 760,000 CONSUMERS OF

GAS ♦ ELECTRICITY ♦ WATER

2,158,857 Total Population Served in Thirty-eight of California's Counties

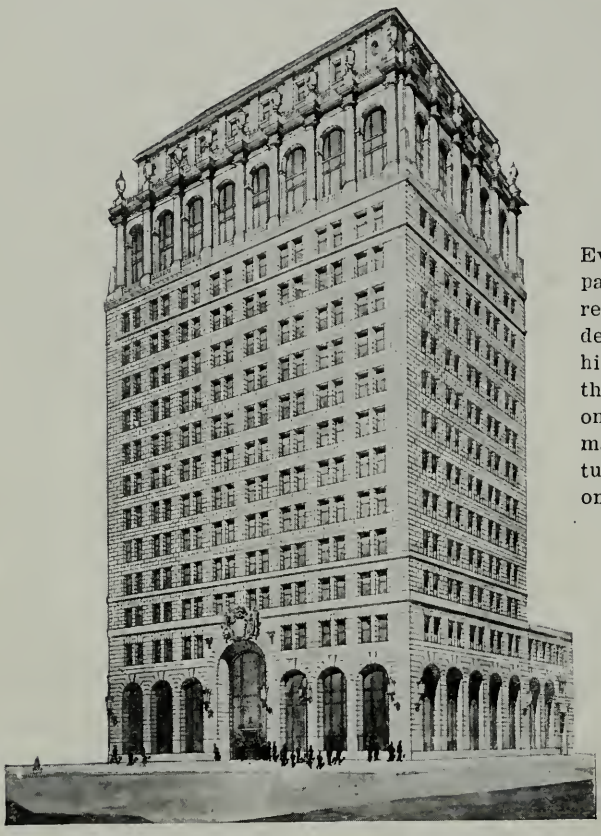
CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL	
	No.	Population	No.	Population	No.	Population
Electricity	244	1,543,459	45	196,370	289	1,740,780
Gas	67	1,458,591	2	11,431	69	1,470,022
Water (Domestic)	24	87,300	5	14,100	29	101,400
Railway	1	83,000			1	83,000

Place	Population
[1]Alameda	31,000
[2]Albany	3,700
Alamo	100
Alta	100
Alvarado	1,100
Alviso	600
Amador City	750
Anderson	900
Angels	941
Angel Island	500
Antioch	2,600
Applegate	100
[6]Aptos	300
Arbuckle	900
Asti	100
[2]Atherton	600
[5-6]Auburn	2,500
Banta	50
[2]Barber	500
[2]Belmont	900
Belvedere	700
Benicia	2,750
[6]Ben Lomond	500
[2]Berkeley	70,000
Bethany	50
[6]Biggs	725
Big Oak Flat	750
Bolinas	300
Boyes Springs	750
Brentwood	400
[2]Broderick	700
Browns Valley	125
[2]Burlingame	8,000
Butte City	300
Byron	350
Calistoga	1,000
[2]Campbell	1,300
Camp Meeker	300
[2]Capitola	350
[6]Carmel	1,800
Cement	1,000
Centerville	1,750
Ceres	1,000
[2]Chico	11,000
Cloverdale	800
[5]Colfax	600
College City	250
Collinsville	300
[2]Colma	2,750
[5-6]Columbia	250
[2]Colusa	2,000
Concord	1,000
Copperopolis	300
Cordelia	350
Corning	1,800
[2]Corte Madera	800
[2]Cotati	400
Cottonwood	450
Coyote	200
Crockett	2,000
Crow's Landing	300
[2]Daly City	5,000
Danville	420
Davenport	500
[2]Davis	1 700
Dayton	60
Decoto	500
[6]Del Monte	300
Denair	400
[5]Dixon	1,000
Dobbins	100
Drytown	200
Duncan's Mills	250
Durham	400
[5-6]Dutch Flat	400
Dunnigan	300
Eldridge	500
[2-6]El Cerrito	1,600
Elmira	300
El Verano	400
[2]Emeryville	5,000
Escalon	700
Esparto	500
[2]Fairfax	1500
Fairfield	1,050
Fair Oaks	400
Fall River Mills	250
Farmington	300
[6]Felton	300
Finley	100
Folsom	2,000
Forestville	300
[1]Fresno	79,500
Gerber	250
Geyserville	500
[6]Gilroy	3,500
Glen Ellen	1,200
[6]Gonzales	500
Graton	150
[3-8]Grass Valley	5,000
[6]Gridley	2,500
Grimes	500
[6]Groveland	400
Guerneville	1,000
Hamilton City	300
Hammonton	500
[2]Hayward	4,500
[6]Healdsburg	2,600
[6]Hercules	400
Hickman	40
[2]Hillsborough	950
[6]Hollister	5,000
Honcut	500
Hopland	500
Hughson	600
Ione	850
Irvington	1,000
[5-8]Jackson	1,900
[5-6]Jamestown	1,000
Kelseyville	600
Kennett	400
[2]Kentfield	750
Kenwood	300
Keswick	20
[6]King City	1,100
Knights Ferry	200
Knights Landing	400
La Fayette	250
[5]La Grange	200
Lakeport	1,200
[2]Larkspur	900
Lathrop	300
[2]Lawndale	60
Lewiston	150
[5-8]Lincoln	1,500
Live Oak	300
[5]Livermore	2,300
[2]Lomita Park	1,250
[5]Loomis	500
Los Altos	800
[2]Los Gatos	3,500
Los Molinos	300
Lylton	100
Madison	300
Manteca	2,000
Mare Island	400
Martell	50
Martinez	4,000
[2]Marysville	8,000
Maxwell	500
[2]Mayfield	1,500
McArthur	125
[2]Menlo Park	3,000
Meridian	250
[2]Millbrae	350
Mills	400
[2]Mill Valley	3,000
Milpitas	350
Mission San Jose	500
Modesto	14,500
Mokelumne Hill	237
[6]Monterey	6,000
Monte Rio	300
[6]Morgan Hill	950
[2]Mountain View	3,200
Mt. Eden	500
[2]Napa	6,800
[3-8]Nevada City	1,800
Newark	1,100
[5]Newcastle	750
Newman	1,500
Niles	1,800
Nord	60
[2-6]Novato	800
Oakdale	2,000
[2]Oakland	265,000
Oakley	200
Occidental	600
Orland	2,000
[3]Oroville	5,500
Pacheco	300
[6]Pacific Grove	3,500
[2-7]Palo Alto	8,181
Paradise	550
Patterson	800
Penn Grove	250
[6]Penryn	250
Perkins	350
[2]Petaluma	7,000
[2]Piedmont	5,000
[6]Pike City	150
[6]Pinole	970
Pittsburg	6,600
Pleasanton	1,100
Port Costa	1,000
Potter Valley	600
Princeton	300
[2]Red Bluff	3,300
[3-6]Redding	3,200
[2]Redwood City	4,500
[2-6]Richmond	35,000
Rio Nida	250
Rio Vista	1,100
Ripon	750
Riverbank	1,200
[5]Rocklin	650
[6]Rodeo	300
[5-8]Roseville	4,500
[2]Ross	800
[4]Sacramento	83,000
Salida	350
[5]Salinas	5,300
San Andreas	250
[2]San Anselmo	4,000
[2]San Bruno	2,000
[2]San Francisco	615,000
[2]San Jose	60,000
[6]San Juan	700
[2]San Leandro	7,500
[2]San Lorenzo	800
[6]San Martin	300
[2]San Mateo	8,500
[2-6]San Pablo	500
[2]San Quentin	3,000
[2]San Rafael	6,500
[6]Santa Clara	6,000
[6]Santa Cruz	16,000
[2]Santa Rosa	9,500
Saratoga	1,200
[2]Sausalito	3,500
[2]Sebastopol	1,750
Shawmut	300
Shasta	50
Shellville	200
Sheridan	250
Smartsville	300
[6]Soledad	400
[6]Soquel	825
Sonoma	1,000
[5-8]Sonora	3,000
[5]Soulsbyville	200
[2]South San Francisco	5 000
Standard	600
[2-7]Stanford University	3,250
Stanislaus	100
[5-6]Stockton	50 000
Suisun	800
Sunol	250
Sunnyvale	2,200
Sutter City	400
Sutter Creek	1,000
Tehama City	150
[5-8]Thermalito	250
Tiburon	500
Towle	50
Tracy	3,200
[6]Tres Pinos	350
[5-6]Tuolumne	2,000
Turlock	4,500
Upper Lake	600
[6]Vacaville	1,300
Valley House	200
[2-6]Vallejo	22,750
Vallicito	150
Vina	300
Vineburg	250
Walnut Creek	900
Warm Springs	300
Waterford	350
[6]Watsonville	6 000
[6]Weaverville	500
Wheatland	475
Williams	800
[3]Willows	2,300
Windsor	600
Winters	900
[2]Woodland	5,600
Woodside	300
Wyandotte	250
Yolo	400
[2]Yuba City	3,500
Total Cities and Towns	1,726,714
Add Suburban Population	432,143
Total Population Served	2,158,857

Unmarked—Electricity only.
[1]—Gas only.
[2]—Gas and Electricity.
[3]—Gas, Electricity and Water.
[4]—Gas, Elect. and St. Railways.
[5]—Electricity and Water.
[6]—Electricity supplied through other companies.
[7]—Gas supplied through other companies.
[8]—Water supplied through other companies.

It Would Take Thirty Buildings Like This



The Company's new General Office Building, San Francisco, which is now approaching completion, will be occupied by approximately one thousand of its eleven thousand employees.

to accommodate
Pacific Gas and Electric
Company's

Thirty Thousand Stockholders

Every one of these numerous partners in "Pacific Service" is receiving regular quarterly dividend checks as a return upon his or her investment. Whether the number of shares owned is one or one thousand, checks are mailed with scrupulous promptitude to reach all stockholders on the same day.

DIVIDEND DATES

Preferred Stock Dividends (6% Annual Rate) are mailed to reach stockholders	*Common Stock* Dividends (8% Annual Rate) are mailed to reach stockholders
Feb. 15	Jan. 15
May 15	Apr. 15
Aug. 15	July 15
Nov. 15	Oct. 15

THE COMPANY'S GROWTH IN FIVE YEARS

	Gross Revenue	Active Meters in Service	Electric Sales (Kw. Hrs.)	Gas Sales (Cu. Ft.)
1920	$34,985,791	569,359	1,042,266,000	10,644,650,000
1921	37,509,707	599,113	1,021,821,000	11,483,551,000
1922	39,204,605	645,410	1,098,123,000	12,353,849,000
1923	39,971,742	710,034	1,198,464,000	13,674,794,000
1924 (12 mos. to Nov. 30)	44,516,128	760,456	1,324,963,000	15,134,360,000

Pacific Gas and Electric Company
Stock Sales Department
445 Sutter Street
San Francisco, Calif.

PACIFIC SERVICE MAGAZINE AND YEAR BOOK

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO

JUN 4 1925



PACIFIC GAS AND ELECTRIC COMPANY'S GENERAL OFFICE BUILDING, SAN FRANCISCO

Vol 16 | APRIL 1925 | No 4

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER
F. B. ANDERSON
CHAS. L. BARRETT
W. E. CREED
W. H. CROCKER
A. B. C. DOHRMANN
JOHN S. DRUM
F. T. ELSEY
D. H. FOOTE
A. F. HOCKENBEAMER
FRANK A. LEACH, JR.
NORMAN B. LIVERMORE
JOHN D. McKEE
JOHN A. McCANDLESS
C. O. G. MILLER

OFFICERS

W. E. CREED . . . . . *President*
FRANK A. LEACH, JR. . . . . *First Vice-President and General Manager*
A. F. HOCKENBEAMER . . . . . *Second Vice-President and Treasurer*
D. H. FOOTE . . . . . *Third Vice-President and Secretary*
CHAS. L. BARRETT . . . . . *Assistant Secretary*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, JR., Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney . . . . . LAW DEPARTMENT
C. P. CUTTEN, Attorney . . . . . RATE DEPARTMENT
R. J. CANTRELL, Manager . . . . . PROPERTY DEPARTMENT
E. W. HODGES, General Auditor . . . ACCOUNTING DEPARTMENT
H. T. TERRY . . . . . CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager . . . . . CREDIT AND STOCK SALES DEPARTMENTS
JOHN H. HUNT, Purchasing Agent . . PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent . . . SUPPLY DEPARTMENT
E. G. McCANN, Manager . . . . PERSONNEL DEPARTMENT

ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT

O. W. PETERSON . . . . . Engineer of General Construction
E. H. STEELE . . . . . Engineer of Line Construction
F. R. GEORGE . . . . . Engineer of Operation
GEO. H. BRAGG . . . . . Engineer of Maintenance

DEPARTMENT OF ENGINEERING

J. P. JOLLYMAN . . . . . Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER . . . . . Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE . . . . . Chief of Division of Civil Engineering
F. M. HARRIS . . . . . Chief of Bureau of Specifications and Estimates
O. A. KNOPP . . . . . Chief of Bureau of Tests and Inspection

DEPARTMENT OF EXECUTIVE ENGINEER

F. C. PIATT . . . . . Valuation Engineer of Electric Properties
J. T. RYAN . . . . . Valuation Engineer of Gas, Water and Railway Properties
B. B. BECKETT . . . . . Rate Engineer
S. B. SHAW . . . . . Automotive Engineer
W. G. JACK . . . . . Manager Land Department

GAS CONSTRUCTION AND OPERATION DEPARTMENT

FRANK WILLS . . . . . Engineer of Production
R. S. FULLER . . . . . Engineer of Distribution
HARRY J. SMITH . . . . . Engineer of Construction

PUBLIC RELATIONS AND SALES DEPARTMENT

R. W. ROBINSON . . . . . Assistant to Vice-President in Charge of Public Relations and Sales
DON C. RAY . . . . . Manager Bureau of Public Relations
N. R. SUTHERLAND . . . . . Manager Commercial Department
H. M. CRAWFORD . . . . . Sales Manager
R. T. STEPHENS . . . . . Manager Electric Sales
FORREST U. NAYLOR . . . . . Manager Gas Sales
J. CHARLES JORDAN . . . . . Manager Publicity Department

W. B. BOSLEY
General Counsel

JOHN P. COGHLAN
Assistant to the President

F. S MYRTLE
Editor-in-Chief Pacific Service Magazine

DIVISIONS AND MANAGERS

DIVISION MANAGERS		DISTRICT MANAGERS		HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION			Marysville
		J. V. KYLE	Colusa District	Colusa
I. B. ADAMS	DE SABLA DIVISION			Chico
H. M. COOPER	DRUM DIVISION			Auburn
		L. H. HARTSOCK	Nevada District	Nevada City
L. H. NEWBERT	EAST BAY DIVISION			Oakland
		J. H. PAPE	Berkeley District	Berkeley
H. C. ROSS	FRESNO DIVISION			Fresno
H. G. RIDGWAY	NORTH BAY DIVISION			San Rafael
		L. J. PETERSON	Petaluma District	Petaluma
		C. D. CLARK	Napa District	Napa
		C. D. CLARK	Vallejo District	Vallejo
		M. G. HALL	Santa Rosa District	Santa Rosa
E. W. FLORENCE	SACRAMENTO DIVISION			Sacramento
		C. W. McKILLIP	Sacramento District	Sacramento
		C. E. SEDGWICK	Solano District	Dixon
		J. W. COONS	Yolo District	Woodland
HENRY BOSTWICK	SAN FRANCISCO DIVISION			San Francisco
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION			Modesto
		W. E. ESKEW	Electra District	Jackson
		C. R. GILL	Modesto District	Modesto
		J. H. FAGG	Stockton District	Stockton
		CHAS. H. NOACK	Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION			San Jose
		W. T. KELLOGG	Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION			Redding
		M. P. WERRY	Pit River District	Fall River Mills
H. B. HERYFORD	WEST SIDE DIVISION			Red Bluff
		STEPHEN GOIN	Willows District	Willows
		CHAS HUGHES	Red Bluff District	Red Bluff

Pacific Service Magazine

Issue of April, 1925

which is also the

Pacific Gas and Electric Company

Year Book of 1924



Executive and management officers of "Pacific Service." At the top is seen President Wigginton E. Creed; to the left First Vice-President and General Manager F. A. Leach, Jr., to the right Second Vice-President and Treasurer A. F. Hockenbeamer. Following these, from left to right, come Third Vice-President and Secretary D. H. Foote; Assistant-Secretary Charles L. Barrett; P. M. Downing, Vice-President in Charge of Electrical Construction and Operation; A. H. Markwart, Vice-President in Charge of Engineering; W. G. Vincent, Jr., Vice-President and Executive Engineer; W. S. Yard, Vice-President in Charge of Gas Construction and Operation; R. E. Fisher, Vice-President in Charge of Public Relations and Sales.

FOREWORD

Following a now established custom, we present to our readers this issue of PACIFIC SERVICE MAGAZINE in the form of a Year Book in which the "Pacific Service" record for the past twelvemonth is respectfully offered for inspection.

We trust that this comprehensive survey of our company's activities during the year 1924 will be accepted as revealing at least an earnest endeavor on the part of our "Pacific Service" working organization in all its branches to contribute toward the establishment of the gas and electric industries in California as leaders in the general progress and development of the State.

With particular reference to the electric industry, the year 1924 was an unusual one. The path of progress was threatened by climatic conditions. The situation, however, had its beneficial side in that it called forth splendid effort on the part of the electric service companies in the determination to overcome difficulties that without the employment of energy and resourcefulness might have seriously hampered industries throughout the State. The result, we think, has done much to advance the public service in the public regard, and we venture to claim for Pacific Gas and Electric Company a prominent part in the good fight that was brought to so successful a conclusion.

In its other activities "Pacific Service" lived up to its well established reputation, constantly bending its energies toward the improvement of service to the consumer. Much was accomplished in this direction. There remains much more yet to be accomplished, but we hope and expect that when the time comes for presenting to our company's patrons and friends the "Pacific Service" record for 1925 our readers will be made aware of still more conspicuous progress in the one really worth while direction, that of SERVICE.

Editor PACIFIC SERVICE MAGAZINE

The "Pacific Service" Record for 1924

As Set Forth in Reports and Addresses Presented to the Stockholders of the Company at the Annual Meeting. President Creed Congratulates the Company Upon a Splendid Showing

The annual meeting of the stockholders of the Pacific Gas & Electric Company was held Tuesday, April 14th, at the company's new general office building at 245 Market Street, San Francisco.

This meeting was invested with a particular personal interest because of the fact that for the first time the handsome structure at the southeast corner of Beale and Market Streets of which "Pacific Service" is so proud was used for a semi-public gathering. The auditorium on the main floor was the meeting place and the response to the personal notices sent out resulted in an unusually representative gathering of stockholders, both men and women, who chose to attend in person rather than be represented by proxy.

President Wigginton E. Creed was in the chair, and reports upon the company's activities during 1924 were presented by First Vice-President and General Manager Frank A. Leach, Jr., and second Vice-President and Treasurer A. F. Hockenbeamer. A noteworthy feature of the proceedings was the address of President Creed in which he called public attention to a record of achievement in the face of unusual conditions.

"The year of 1924, in my judgment, placed a greater strain, imposed a more severe test, upon the men of 'Pacific Service' than even did the war period," said President Creed. "It was the eighth successive year in which the precipitation throughout the State was subnormal. There was a shortage of water and a consequent curtailment of power supply to south and north of us. But, *we went through that year without refusing a new customer and without curtailing service to any of our old customers.*

"We did that and we did more, for we helped our neighbors to south and north of us.

"In my opinion, that is a good way to judge an organization. Under the stress of the abnormal conditions referred to we were involved in an additional expenditure of two and one-half millions for the manufacture and delivery of electric energy. Yet, in the face of that we have been enabled at the close of the year to carry a sum of $750,000 over to surplus. It was just a case of human service."

Mr. Creed pointed out the excellent effect of a record like this upon the credit of the company in the great investing centers of the country. "The average cost to the prime companies of raising money by bond issues is generally calculated at over six per cent. We issued bonds twice last year, and each time at a cost of

under six per cent," said Mr. Creed. "That meant a saving of $3,000,000 to the company in interest charges over the life of the bonds sold by the company during the year, the aggregate amount being $25,000,000. Furthermore, we issued $10,000,000 of common stock during 1924. The average cost of disposing of a stock issue is generally rated at from $4.00 to $4.50 a share. We sold ours for five cents a share, and all that was involved was the clerical work."

President Creed spoke of the great industrial expansion in progress from north to south in California. It meant business for the power companies, he said, and already manufacturers were not only asking for power for their several enterprises but were suggesting ten-year contracts. Concerning the outlook for 1925 it might be said that business, both gas and electric, was growing at a little over ten per cent per annum. This increase was due in part to new customers and in part to old customers increasing their use of the product supplied them." "Diversity," said Mr. Creed, "makes the dollar work longer hours." Concerning the particular section of California covered by the Pacific Gas and Electric Company's operations he felt conditions to be sound everywhere.

"Our company is strong, its position is right, and the future will justify the faith we have in California and the position we seek to occupy as the advance guard of progress and development," said President Creed in conclusion.

At this annual meeting the following officers and directors were chosen for the ensuing year:

President, W. E. Creed; First Vice-President and General Manager, Frank A. Leach, Jr., Second Vice-President and Treasurer, A. F. Hockenbeamer; Third Vice-President and Secretary, D. H. Foote; Assistant Secretary, Chas. L. Barrett. Directors—Wallace M. Alexander, F. B. Anderson, Chas. L. Barrett, W. E. Creed, W. H. Crocker, A. B. C. Dohrmann, John S. Drum, F. T. Elsey, D. H. Foote, A. F. Hockenbeamer, Frank A. Leach, Jr., Norman B. Livermore, John D. McKee, John A. McCandless, C. O. G. Miller.

A Year of Accomplishment in Construction, Maintenance and Operation

Report of First Vice-President and General Manager Frank A. Leach, Jr., Presented to the Stockholders a Summary of the Activities of "Pacific Service" in Serving the Homes and Industries of California

Mr. Leach declared the year of 1924 to have been, "a year of accomplishment in construction, maintenance and operation," and, as did President Creed in his address, he instanced the accomplishment of uncurtailed service to all our company's customers and industries in the face of unusual conditions, an accomplishment, as he said, "possible only through the skill, loyalty and devotion of our engineering, construction and operating forces."

One accomplishment in particular was dwelt upon. This was the construction and installation of a 12,500 kilowatt addition to the electric generating equipment of our company's steam-electric station on the riverbank at Sacramento. This, indeed, was an accomplishment to be proud of. The order for the steam unit was placed on February 2nd, 1924, and was completed and put in operation June 15th, a period of four months and a half. As a result, our company was able to take care of a section of its territory where any failure of service would have entailed serious inconvenience to a number of industries in a prosperous and rapidly growing community.

Another point touched upon was the skill with which the water resources of "Pacific Service" were handled, every gallon of water being conserved to carry the peak loads by the hydroelectric plants. In this connection the work of enlarging storage facilities at Lake Fordyce progressed rapidly, so that before winter shut down upon operations the dam had been raised 12 feet, thereby increasing the storage capacity of the reservoir by 6,364 acre feet for 1925 storage.

Mr. Leach's report contained the following table of major projects completed, variously, by the construction forces of the company, both electric and gas:

March 16th: Bullard's Bar Power House paralleled with system, adding another hydroelectric plant to our chain.

April: Claremont-Newark tower line placed in service.

June 9th: Radio transmitting and receiving apparatus from Oakland to Pit River power plants placed in service.

June 17th: 12,500 kilowatt capacity steam turbine placed in service at Sacramento.

August 7th: A new steam station known as Station "T" placed in service on Stevenson Street in San Francisco.

August 20th: There was added to our system a new 12-foot gas generator at San Rafael.

September: A 50,000 cubic foot relief holder erected at Marysville.

September: Gas connection made to the distributing system of the city of Santa Clara.

September 30th: A new 16-foot improved oil gas generating set completed at Station "B" in Oakland.

October 30th: A new 3,000,000 cubic foot storage holder completed at San Jose.

November 8th: A 15-foot improved oil gas generator installed at Sacramento.

November 10th: Drum afterbay completed, giving greater peaking facility on the South Yuba System.

December 5th: Tunnel 4.01 miles long holed through on Pit Number Three Development.

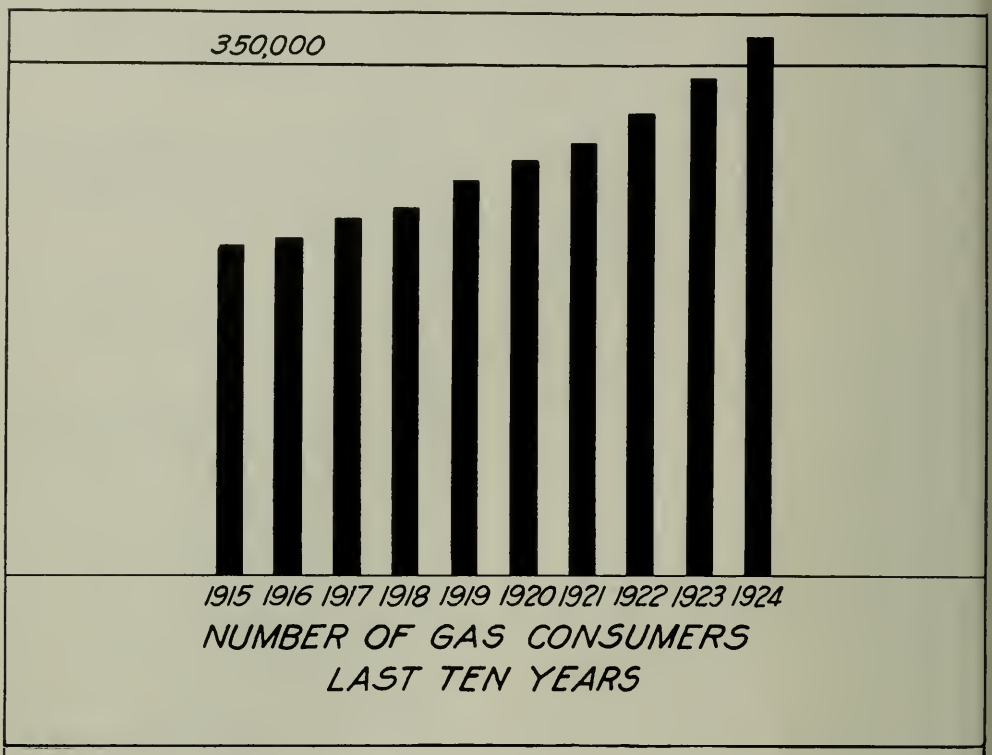
December 22nd: There was completed at San Jose a new 15-foot improved oil gas generator.

December 24th: Two 18-foot improved oil gas generators placed in service at the Potrero Gas Plant, San Francisco.

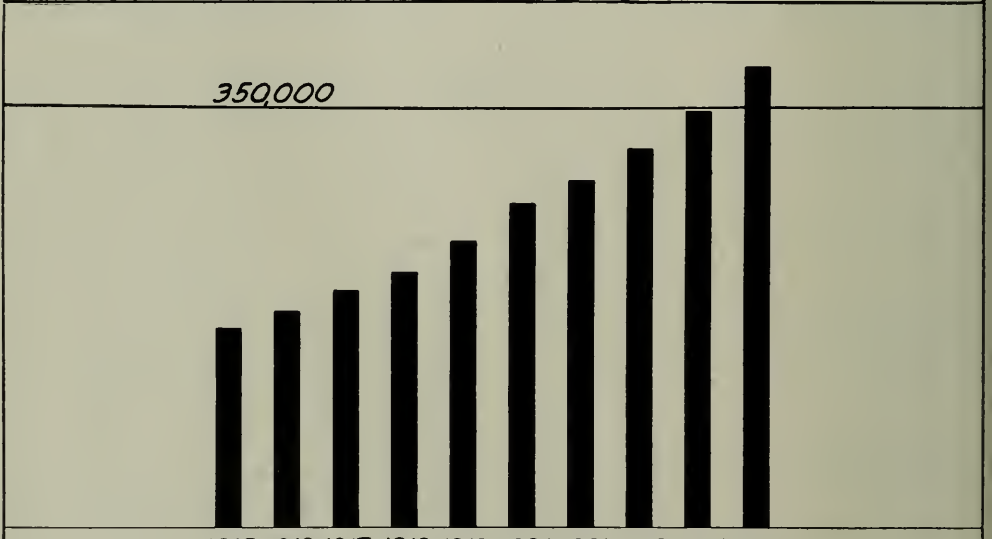
December 24th: A new 3,000,000 cubic foot storage holder placed in service at Sacramento.

December 31st: A new 3,280,000 cubic foot gas holder placed in service at North Beach Station, San Francisco.

Mr. Leach expressed his sincere appreciation of the loyal and effective work of his associate officers and employees to whom, he said, was due the credit for the splendid results accomplished during 1924. Then followed a comprehensive survey of the work of the various departments included in the operating division of our company's working organization.



NUMBER OF GAS CONSUMERS
LAST TEN YEARS



NUMBER OF ELECTRIC CONSUMERS
LAST TEN YEARS

Ten Years of Service Progress

During the ten years' period from 1914 to 1924 the "Pacific Service" record shows remarkable gains made in the number of our company's consumers of gas and electricity and in its manufacturing and distributing facilities by which it has been able to place continuous and dependable service at the disposal of those consumers.

On the opposite page are displayed two charts showing, respectively, the increase in the number of our company's gas and electric consumers during the ten years' period referred to. Taking the figures as of December 31st, 1914, up to and including December 31st, 1924, embracing a period of ten years, the following increases in service reveal the course of progress and development in our "Pacific Service" territory:

Number of gas consumers: 1914, 220, 360; 1924, 365, 396. Gain, 145,036.

Electricity served to 175 cities and towns in 1914 and to 288 cities and towns in 1924, an increase of 113, or 65 per cent; gas to 50 cities and towns in 1913, 68 cities and towns in 1924, an increase of 18, or 36 per cent; water to 20 cities and towns in 1913, 29 cities and towns in 1924, an increase of 9, or 45 per cent.

In 1914 employed approximately 5,000 people; in 1924, 9,936 people.

Served 30 of California's 58 counties in 1914 with an area of 38,000 square miles; in 1924 served 38 counties with a territory of 59,000 square miles, an area greater than that of England and Wales.

Growth of territory: Population served has increased from 1,220,238 to 2,157,957, an increase of 937,719, or 77 per cent.

Among the principal industrial centers served by "Pacific Service" are San Francisco, Oakland and Sacramento.

The growth for the past ten years in the number of manufacturers for San Francisco is 81 per cent, Oakland 40 per cent, Sacramento 70 per cent; capital investment, San Francisco 100 per cent, Oakland 162 per cent; output, San Francisco 208 per cent, Oakland 840 per cent, Sacramento 144 per cent; payroll, San Francisco 224 per cent, Oakland 690 per cent, Sacramento 164 per cent. Number of employees, San Francisco 55 per cent, Oakland 264 per cent, Sacramento 30 per cent.

These percentages of increases show the wonderful development along industrial lines with which "Pacific Service" has kept pace and in which it has been a contributing factor.

The Financial Side of "Pacific Service"

A. F. Hockenbeamer, Second Vice-President and Treasurer, outlines monetary results of the year's operations. Substantial growth in earnings and assets.

This, the first meeting in our new General Office Building, reminds me that since my connection with the Company, it has occupied four different General Offices, and it is rather an interesting coincidence that during the same period the Company's business has grown almost exactly fourfold, namely, from $11,342,140 in 1907 to $44,935,419 in 1924.

The 1924 annual report, which has been distributed among you, is divided into three sections:—the first dealing with the income and outgo of our operating departments, the second with certain balance sheet items, such as the plants and properties account, the Company's capitalization and its working capital, and the third with matters pertaining to the physical side of the Company's activities. This report may appear to be voluminous, but it deals with a large company, engaged in six distinct business activities, and which in 1924 passed the quarter billion dollar mark in its capitalization. Then also, we have used our best efforts to leave no dark corners. We believe the stockholders are entitled to the fullest information and have endeavored in this report to give it to them.

I will review, very briefly, the financial features of this report:

Gross operating revenue amounted to $44,451,586, derived to the extent of 60 percent from the electric department, 35½ percent from the gas department, and 4½ percent from the water, street railway, steam sales and telephone departments.

In comparison with 1923, gross operating revenue increased $5,130,051, and was accompanied by the net addition of 53,582 customers, and by an increase of more than 11 percent in electric energy and gas sales, measured in kilowatt-hours and cubic feet respectively. Measured in dollars and cents, this increase was almost equally divided between the electric and gas departments. The showing of the gas department was helped by two increases in gas rates in the early part of 1924, which, combined, averaged about 8 2/3 cents per thousand cubic feet over the entire system. These increased rates were authorized by the Railroad Commission in conformity with the plan instituted by it in August, 1921, under which gas rates are automatically adjusted, within 30 days, to conform to the cost of oil to the Company. Since this policy was established, there have been three downward revisions of gas rates, averaging about 15.7 cents per thousand cubic feet, and three upward revisions, averaging about 13.3 cents per thousand cubic feet.

The ordinary significance of Leap Year is generally understood, but it

may surprise you to learn that the extra day in 1924 meant the addition of about $140,000 to our gross revenues.

Our sales of electric power in 1924 amounted to $12,327,806 and constituted 46 percent of the Company's entire electric business. Power sales have increased 78 percent in the last five years.

Our operating expenses increased by $5,360,624. Eliminating from this, $2,500,000 of extraordinary expenses forced upon us by the drought conditions in 1924, we find that with respect to the ordinary outgo for maintenance, operation, taxes, etc., our operating ratio in 1924 was lower than in 1923. This is indicated by the fact that in 1923, 60 cents out of every dollar of gross operating revenue was expended for those items, as against 57.8 cents in 1924.

With the exception of oil, there was no substantial change during the year either in the average cost of labor or of materials. The average monthly wage of all employees was $145.38 in 1924, as against $142.84 in the preceding year. Our index of the cost of materials and supplies shows average prices to have been 3.6 percent less at the close of 1924 than at the close of 1923, but still 59 per cent above pre-war levels.

We paid out in taxes $3,922,678. This was somewhat less than in 1923, owing to smaller Federal Income Taxes, but nevertheless absorbed nearly 9 cents of every dollar of operating gross, and about 19½ percent of net operating income.

Maintenance charges aggregated $2,946,463, and were $496,516 less than in 1923. As a partial offset to the extraordinary operating expenses induced by drought conditions, maintenance expenditures were reduced to the minimum consistent with good service and the avoidance of any impairment of the property.

After deducting from gross operating revenue all operating and maintenance costs, there was left as net earnings from operation, $16,248,490, representing an increase of $420,365, compared with 1923. In view of the greatly increased volume of new business and of the large amount of new capital invested during the year, this increase is relatively small. Considering, however, that the conditions which compelled a temporary increase of $2,500,000 in operating expenses have now disappeared, the correct view is that the benefits to which the Company is entitled from the additional business and the additional capital investment were, through unavoidable circumstances, merely deferred and should be realized under the present normal operating conditions. The ability to show any increase at all in net income in the face of the worst operating conditions in seventy years, is evidence of the fundamental soundness of the Company's position, of the resourcefulness of its organization and of the stabilizing influence of its diversified sources of revenue.

Adding $483,833 of non-operating revenues to the net earnings from operation, gives a total of $16,732,323 available for the payment of bond interest. Bond interest and amortization of bond discount and expense came to $6,646,557, leaving a balance of $10,085,766. This is the largest margin by which we have ever earned our interest charges, and is largely the result of the investment in the prop-

erties of the proceeds of $51,643,079 of Preferred and Common Stocks sold during the past ten years, and of the consistent adherence for many years to our policy of retaining in the business a reasonable proportion of surplus earnings. The bonds of the Company have had an assured investment position for many years and the cumulative effect of these conservative financial policies is apparent in the readiness with which the Company is able to dispose of new issues at prices available only to public utilities of the highest credit. Its bond issues are now held by 40,000 to 50,000 investors, among which are numbered some of the most important financial institutions in the United States.

After a further deduction of $3,057,417 as a reserve for future renewals and replacements, there remained a surplus available for the payment of dividends of $7,028,349, an increase, compared with the preceding year, of $272,055. Dividends on the Preferred Stock at the rate of 6 percent, and on the Common Stock at the rate of 8 percent were paid during the year, leaving a balance of $743,618 to be transferred to undistributed surplus, which at the close of 1924 stood at $9,760,960.

The total outstanding bond and stock capitalization of the Company at the close of 1924 was $250,627,644, of which $153,357,300, or about 60 percent was in bonds, with an average face rate of interest of 5.4 percent, and $97,270,344, or about 40 percent, in Preferred and Common Stocks. The present day value of the Company's tangible properties is largely in excess of this total capitalization, and there is today a sounder relationship between outstanding securities and property values than at any time in the Company's history; and the same thing may be said of the earning power of the properties, to which we must look for the payment of interest and dividends. In the past ten years, the net cost of additional properties exceeded by $60,735,000 the net increase in funded debt; by $25,072,000 the combined increase in bonds and preferred stock; and by $14,375,000 the total increase in bonds, preferred stock and common stock. During 1924 the Company earned on its total capitalization the very moderate return of 6.67 percent and, as already stated, the real value of the properties is substantially in excess of this capitalization.

The Company's current assets, such as materials and supplies, bills and accounts receivable, etc., including $11,485,168 cash, stood at $28,925,780, at the close of 1924. Against these current assets there were current liabilities of $8,541,541, leaving a balance of net working assets of $20,384,239. Our business was conducted on a cash basis throughout the year and a saving of $89,962 effected by taking advantage, wherever possible, of cash discounts offered for the prompt payment of bills.

The Company is at this time owned by something like 32,000 stockholders, with average holdings of 30½ shares. At the close of the year, 15,621, or 53.3 percent of the stockholders, owned 10 shares or less, and only 4 percent of the total number of stockholders owned to exceed 100 shares.

CONSOLIDATED INCOME STATEMENT

YEAR ENDED DECEMBER 31, 1924.

Gross Earnings, Including Miscellaneous Income	$44,935,419.31
Maintenance, Operating Expenses, Rentals, Taxes (Including Federal Taxes) and Reserves for Casualties and Uncollectible Accounts	28,203,096.28
Net Income	$16,732,323.03
Net Interest Charges	6,262,263.61
Balance	$10,470,059.42
Bond Discount and Expense	384,293.42
Balance	$10,085,766.00
Reserve for Depreciation	3,057,416.54
Balance to Surplus	$ 7,028,349.46
Dividends Paid on Preferred Stock (6 percent)	3,244,608.74
Balance	$ 3,783,740.72
Dividends Paid on Common Stock (8 percent)	3,040,122.70
	$ 743,618.02

CONDENSED BALANCE SHEET, DECEMBER 31, 1924

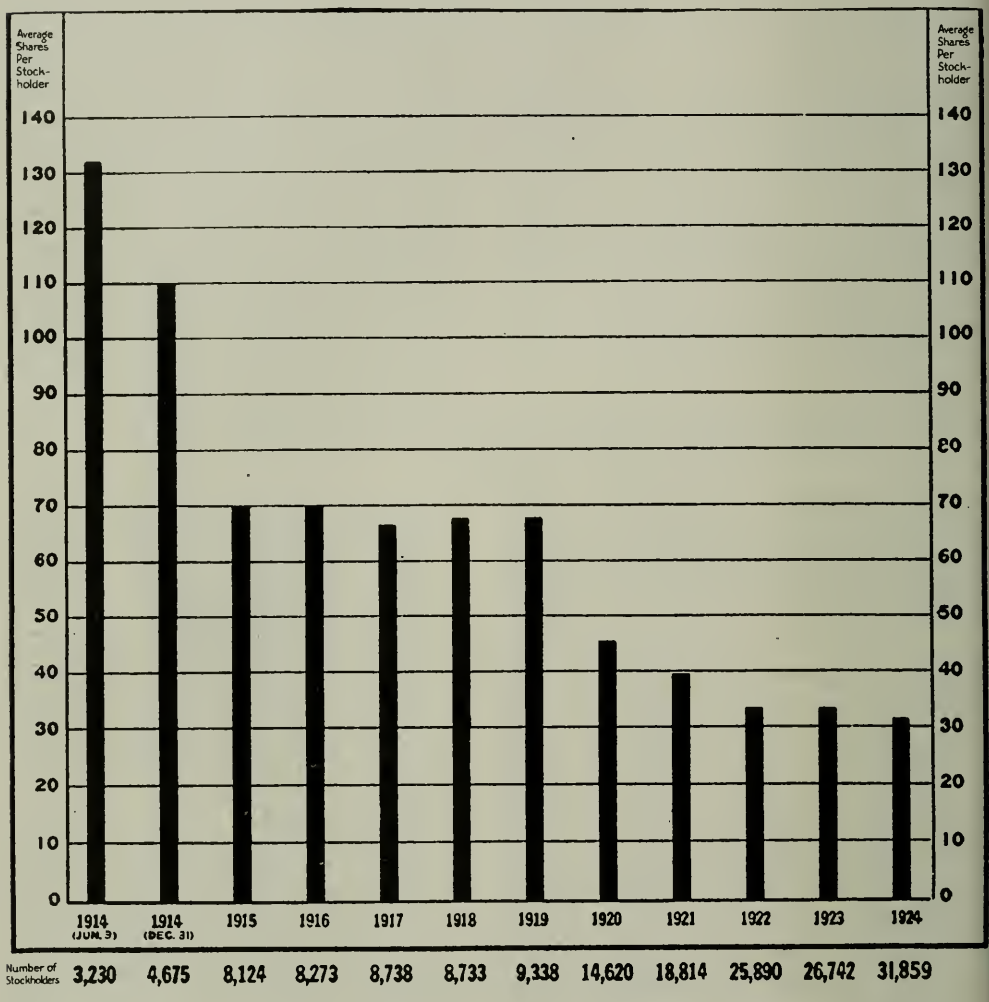
ASSETS

Plants and Properties		$249,178,251.62
Discount and Expense on Capital Stock		9,104,811.86
Trustees of Sinking Funds (Uninvested Funds)		228,507.02
Current Assets—Cash	$11,489,575.77	
Other	11,554,759.87	23,044,335.64
Discount and Expense on Funded Debt in process of amortization		8,148,977.33
Unexpired Taxes, etc.		297,754.72
Total Assets		$290,002,638.19

LIABILITIES

Common Stock Outstanding	$ 42,805,931.67
Preferred Stock Outstanding	54,464,411.91
Stock of Subsidiary Companies owned by public	18,775.34
Funded Debt in hands of public	153,357,300.00
Current Liabilities	8,541,541.38
Reserve for Renewals and Replacements	17,062,383.64
Other Reserves	3,991,333.82
Surplus Unappropriated	9,760,960.43
Total Liabilities	$290,002,638.19

A Lesson in Public Ownership



The field of corporate ownership throughout the country is steadily expanding. Countless thousands are learning to invest their savings in stocks and bonds. In 1910 there were 7,000,000 stockholders in the United States. Today there are over 14,000,000.

One factor contributing strongly toward this widespread dissemination of securities among the mass of the people is the "Customer Ownership Plan," initiated by the Pacific Gas and Electric Company in 1914. At that time the Company had 3,000 stockholders with average holdings of 131 shares. There are now 32,000 stockholders averaging 30 shares each. The chart tells the story.

The Year's Progress in the Department of Engineering

The work of the Engineering Department consists principally of the following: Surveys and analyses of present and probable future conditions of the electric, steam and water ends of the company's business; a great many diversified studies which involve problems of engineering and economics; the evolving of the necessary construction program to meet future growth; the investigation of each individual project with a view to its development; finally, the design of all new construction and improvements to hydroelectric and steam electric generating stations, substations, transmission distribution lines, and service buildings.

A rough idea of what is involved in the above can be obtained when it is realized that the average hydroelectric plant requires about three years to build and that our load studies must therefore serve to predict load conditions both as to total kilowatt hours and peak demands for the system five to ten years ahead. Preliminary studies were made on three specific hydro-electric projects other than those of Pit River. In addition the department, through its various personnel, investigated numerous power project proposals submitted to the company, some of which required extensive office studies as well as field reconnaissance.

As a more or less special study the Engineering Department has been supervising the construction of the new general office building in San Francisco, the division office building in San Jose, and the Emeryville warehouse group.

Inspections and testing of all equipment and materials entering into construction were conducted both locally and at eastern manufacturing centers and a considerable volume of standardization work was accomplished.

More specifically the work in progress in each of the three major divisions into which the Department is divided may be outlined as follows:

The Division of Hydro-electric and Transmission Engineering practically completed the electrical plans for the construction of Pit No. 3 development and in addition, those for the reconstruction of Volta Power House and the cutting over to automatic operation of Coal Canyon and Cow Creek Power Houses. In addition plans were completed, or very nearly so, for the Pit No. 3 and Vaca-Contra Costa 220 KV transmission lines, and for the Delta-Shasta and a section of the Newark-Martin 110 KV transmission lines. Preliminary plans have been completed for the Contra Costa-Livermore and the Newark-Salinas transmissions. Plans for various detours and changes were made with regard to thirteen major sections of the 60 KV system. Plans were substantially completed for the carrier current radio installation at Claremont Substation and for the conversion of the Pit No. 1 and Vaca-Dixon radio systems to the interphase duplex type which is considered much more effective. With regard to 220 KV and 110 KV substations, plans were nearly completed for the Vaca-Dixon extension, 50th Avenue Substation and New Martin extention. Plans are under way for the Contra Costa, Shasta and Newark Substations. With regard to 60 KV stations, plans were completed for thirty-one substations and preliminary investigations were made on twenty stations.

As to the activities of the *Division of Electric Distribution and Steam Engineering,* plans were completed for a new station in San Francisco, two new stations in Oakland, additions to six stations in San Francisco and to one station in Oakland. Plans were completed for approximately 15 miles of conduit lines and 50 miles of cable; for

the installation of a consumers' substation at the Metal & Thermit Company, South San Francisco; for the replacement of stack at steam Station "S" San Francisco and for the installation of a 12,500 KW steam turbine at Station "B" Sacramento. This latter job received considerable comment, not because it was more difficult than others but because of the extremely short time available to do the work and the large amount of forced effort therefor required. In addition to the foregoing a complete and exhaustive study as to possible additions and betterments to the steam generating system was conducted; work on the standard specifications for overhead, underground and street lighting distribution was continued and several of the standard specifications were revised and brought up to date.

The Division of Civil Engineering through its field forces made preliminary and final location surveys for all of the construction projects, the major part of which were on the Pit River. The office force prepared in cooperation with other divisions, all drawings of structural and hydraulic character, such as dams, conduits, power houses, transmission towers, substation buildings, division offices, service group buildings and numerous special structures connected with steam electric and hydroelectric installations. The work of this nature carried on was substantially in connection with the various projects outlined above except for the new central warehouse plans which were partially completed. In certain cases services of a structural character were performed for the Department of Gas Construction and Operation.

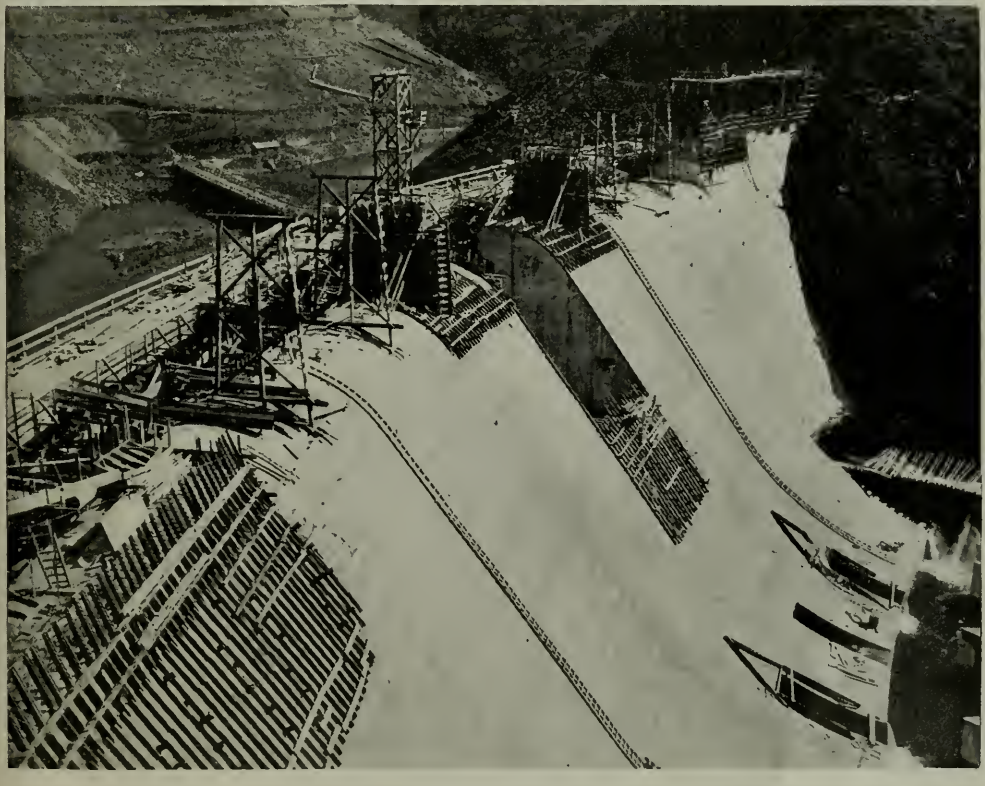
To summarize, the work for the year 1924 did not, as did some of its immediate predecessors, involve striking new developments in engineering. Its main feature, aside from the planning of Pit No. 3, a 108,000 horsepower development, which will reflect to the credit of the Department, was rather the carrying on of a large number of smaller projects which, though not as spectacular as the high voltage developments which frequently have to reach out beyond the present known limits of engineering practice, were nevertheless fully as important inasmuch as it is these every day developments which must of necessity form the basis of the Company's system and service. On the whole the work done by the Department of Engineering during 1924 was considerably greater than that of previous years and it appears that the work for 1925 will be in even greater volume.

Problems Met By Construction and Operation Department

The Department of Electric Construction and Operation, having to do with the construction, operation and maintenance of the electric, steam, water and railway properties of the company, was particularly active during the year 1924. Not only did it have under way an unusual number of major construction jobs but it also had before it the bigger problem of supplying the rapidly growing demands for electric service during one of the shortest water years the State has ever known.

In the construction end of our work the Pit Number Three Development probably attracted wider public interest than any other of the company's activities. Started during the latter part of 1923, construction work on the dam, tunnel and power house progressed rapidly throughout the past year. Weather conditions during the early spring and summer months were particularly advantageous to construction work and rapid strides were made in every department. In fact, so well has the work progressed that throughout the year it has always been up to the schedule determined upon before starting and there is no reason to think that the plant will not be completed and ready for operation by July of this year.

At the outset we realized that the greatest uncertainty in connection with this project and the item of work that would determine the final date of completion was the tunnel. Complete drillings along the entire length to determine the character of



The diversion dam at Pit Number Three development under construction. View of the down-stream face of the dam.



Another view of the diversion dam at Pit Number Three. Flume for diverting water from river bottom shown at right. Concrete plant at upper left.

ground through which it would run were not made in advance, so that no hard and fast predetermined plan for handling the work could be decided upon. As the work progressed, the formation was found to be very irregular and called for almost daily changes in methods of handling; but, notwithstanding this handicap splendid progress was made and the 600 feet driven during the month of August establishes what, so far as we have been able to find, is a new world's record for driving an all-timbered tunnel having inside dimensions of approximately 23 feet. Great credit is due Construction Superintendent G. M. Wehrle, General Tunnel Foreman Dick Scott and others who had to do with this work for the splendid way in which it was handled. Although tunnel work is generally considered by insurance carriers as an extra hazardous occupation, it is a noteworthy fact that during the entire progress of this job there was not a single fatality or permanent disability accident.

Next in importance to the Pit Number Three job was the raising of Fordyce Dam to give an additional 26,620 acre feet of stored water. The water thus impounded will be utilized through four different plants on the South Yuba system, namely, Spaulding No. 1, Drum, Halsey and Wise, after which it will be available for domestic and irrigation purposes in lower Placer County. Before actual construction work could be started it was necessary to build 9 miles of road from the State Highway near Cisco over the mountain to Fordyce Dam. This was completed, camp was established and a large portion of the construction plant installed during 1923. During the five months working season of 1924 rock quarries were opened, the wood facing on the old dam replaced with concrete and new work on the structure carried up to a point where an additional 10,000 acre feet of water will be stored for use during the short water period of 1925. Work on this project was of necessity

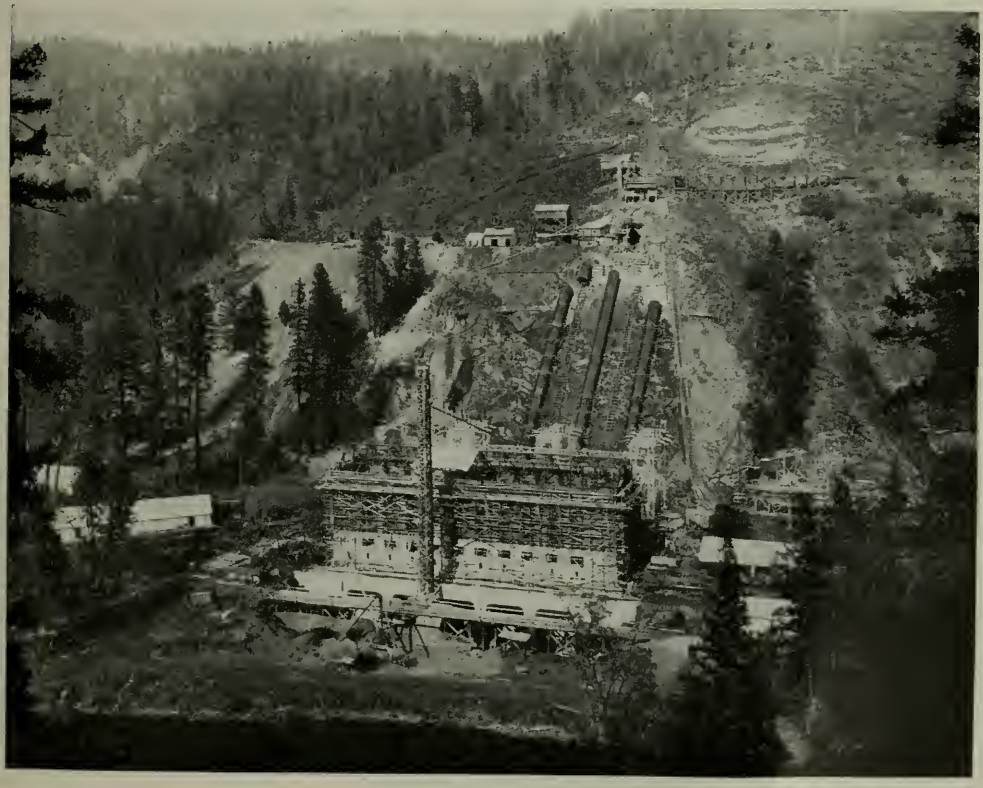
closed down during the winter on account of heavy snows. This spring work will be resumed as early as the snow will permit and will be completed before the winter of 1925-26.

Drum Afterbay Dam, 95 feet in height and 324 feet long, was constructed across Bear River just below Drum power plant. This structure forms a regulating reservoir having a capacity of 280 acre feet. Its purpose is to temporarily store such excess water as may be discharged through Drum Power House during heavy load periods in order that it may be released when the load is light, thus to give a more nearly uniform flow through Halsey and Wise Power Houses and for supplying the irrigation demands in Placer County.

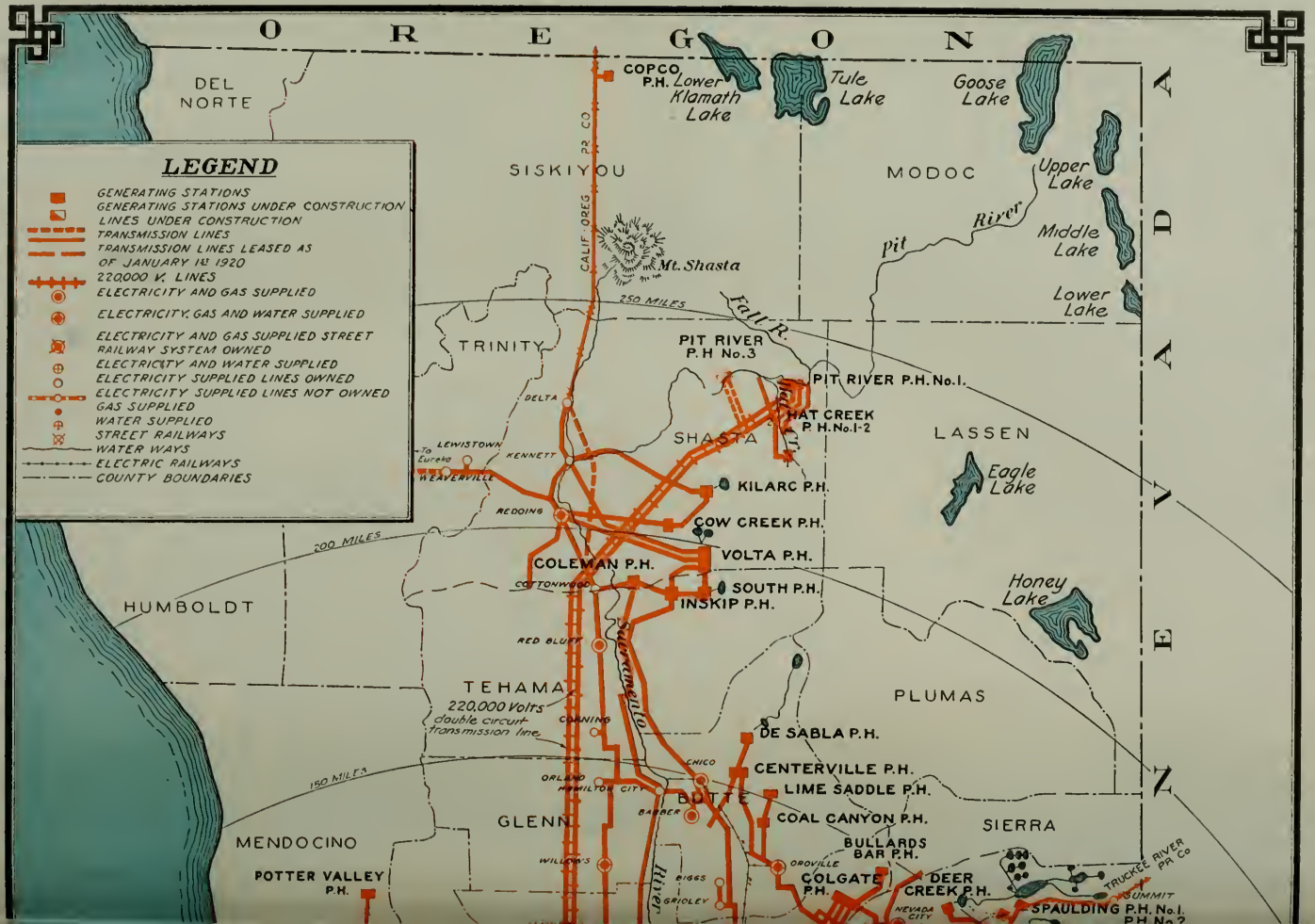
Concurrently with the work on the afterbay a portion of the second penstock or pipe line was added at Drum plant. This new pipe line varies from 72 to 52 feet in diameter and its installation will increase the peak capacity of the plant from 32,000 KW to 37,500 KW.

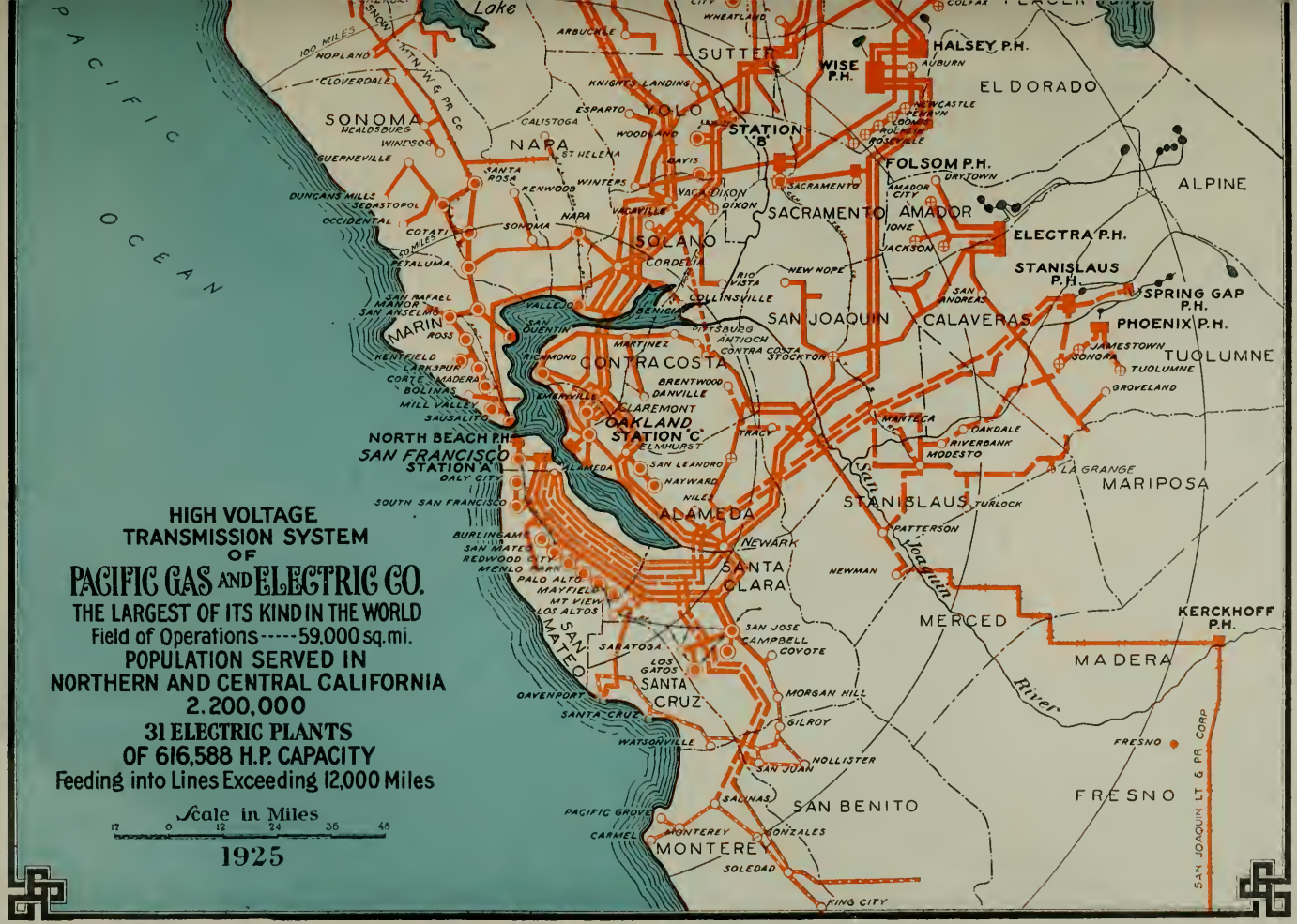
Bullard's Bar Dam and Power House built by the Yuba River Power Company was completed, put into operation and, in accordance with our agreement with that company, accepted by us on March 16, 1924. This plant is located on the North Yuba River, a short distance above the existing Colgate headdam. It not only adds an additional 8125 kilowatts of capacity to the system but it also makes available for use at Colgate an additional 14,000 acre feet of stored water or approximately sufficient to maintain a full head at that plant during the short water period of a normal year.

The most important activity on the steam end of our work was the installation of a new 12,500 KW turbine in the Sacramento Steam Station. The abnormally low precipitation during the winter of



Pit Number Three powerhouse nearing completion. Will be ready for operation in July


OREGON
NEVADA
LEGEND
GENERATING STATIONS
GENERATING STATIONS UNDER CONSTRUCTION
LINES UNDER CONSTRUCTION
TRANSMISSION LINES
TRANSMISSION LINES LEASED AS OF JANUARY 1st 1920
220,000 V. LINES
ELECTRICITY AND GAS SUPPLIED
ELECTRICITY, GAS AND WATER SUPPLIED
ELECTRICITY AND GAS SUPPLIED STREET RAILWAY SYSTEM OWNED
ELECTRICITY AND WATER SUPPLIED
ELECTRICITY SUPPLIED LINES OWNED
ELECTRICITY SUPPLIED LINES NOT OWNED
GAS SUPPLIED
WATER SUPPLIED
STREET RAILWAYS
WATER WAYS
ELECTRIC RAILWAYS
COUNTY BOUNDARIES
DEL NORTE
SISKIYOU
MODOC
TRINITY
SHASTA
LASSEN
HUMBOLDT
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
MENDOCINO
COPCO P.H.
Lower Klamath Lake
Tule Lake
Goose Lake
Upper Lake
Middle Lake
Lower Lake
Pit River
Mt. Shasta
CALIF. OREG. P.R. CO.
250 MILES
Fall R.
PIT RIVER P.H. No.3
PIT RIVER P.H. No.1.
HAT CREEK P.H. No.1-2
Hat Cr.
DELTA
To LEWISTOWN
To Eureka
KENNETT
WEAVERVILLE
REDDING
KILARC P.H.
COW CREEK P.H.
VOLTA P.H.
COLEMAN P.H.
COTTONWOOD
SOUTH P.H.
INSKIP P.H.
200 MILES
Eagle Lake
Honey Lake
RED BLUFF
Sacramento
TEHAMA
220,000 Volts
double circuit
transmission line
CORNING
DE SABLA P.H.
CHICO
CENTERVILLE P.H.
ORLAND
HAMILTON CITY
LIME SADDLE P.H.
BUTTE
BARBER
COAL CANYON P.H.
150 MILES
BULLARDS BAR P.H.
WILLOWS
OROVILLE
BIGGS
GRIDLEY
Feather River
COLGATE P.H.
DEER CREEK P.H.
NEVADA CITY
TRUCKEE RIVER P.P. Co
SUMMIT
SPAULDING P.H. No.1
P.H. No.2
POTTER VALLEY P.H.


HIGH VOLTAGE
TRANSMISSION SYSTEM
OF
PACIFIC GAS AND ELECTRIC CO.
THE LARGEST OF ITS KIND IN THE WORLD
Field of Operations-----59,000 sq.mi.
POPULATION SERVED IN
NORTHERN AND CENTRAL CALIFORNIA
2,200,000
31 ELECTRIC PLANTS
OF 616,588 H.P. CAPACITY
Feeding into Lines Exceeding 12,000 Miles
Scale in Miles
17 0 12 24 36 48
1925
PACIFIC OCEAN
Lake
SONOMA
NAPA
SOLANO
YOLO
SUTTER
EL DORADO
ALPINE
AMADOR
SACRAMENTO
MARIN
CONTRA COSTA
SAN JOAQUIN
CALAVERAS
TUOLUMNE
ALAMEDA
STANISLAUS
MARIPOSA
SANTA CLARA
MERCED
SAN MATEO
SANTA CRUZ
MADERA
FRESNO
SAN BENITO
MONTEREY
STATION A
SAN FRANCISCO
STATION B
STATION C
OAKLAND
NORTH BEACH P.H.
HALSEY P.H.
WISE P.H.
FOLSOM P.H.
ELECTRA P.H.
STANISLAUS P.H.
SPRING GAP P.H.
PHOENIX P.H.
KERCKHOFF P.H.
San Joaquin River
SAN JOAQUIN LT & PR CORP



Steel tower line carrying "Pacific Service" between Hat Creek and Cottonwood. The line crossing Burney Mountain.

923-1924 very early in the year indicated e certainty of a water shortage at the ydro plants and pointed out the necessity doing everything reasonably possible in e way of adding to the capacity of the eam plants. Fortunately, when the orig- al installation was made at Sacramento, ovision was made for a second turbine it with the necessary boilers, etc. Splen- d cooperation on the part of the manu- cturers by giving our work preference d the right of way through their shops abled us to get quick deliveries on all uipment thus enabling us not only to get e unit into service before the extreme w water period came on but it also en- led us to complete the job in remarkably ort time. The turbine was ordered from e General Electric Company on January 9th, 1924. It left Schenectady, New ork, on April 26th, 1924, arriving in acramento on May 16th, 1924, and so well had the work been planned by Mr. McKay and the man under him that within twenty-four hours after it was first turned over on June 17th, it was carrying full load and continued to do so almost every hour right up to the time when the stream flows picked up to a point where steam could be backed off.

The most important transmission line work done during the year was the construction of two single circuit 220,000 volt lines from Pit Number Three to connect with the Pit Number One-Vaca line near Burney, a twin circuit 110,000 volt tower line from Claremont to connect with the Newark-Oakland line near Elmhurst and the construction of a new 60 KV line for the greater part of the distance between Mountain View and Davenport. Work was also started on a twin circuit 110,000 volt tower line from Newark to San Francisco and a single circuit 110,000 volt pole

line from Cottonwood to connect with the new line being constructed by the California-Oregon Power Company at Kennett.

A large number of substations have been rebuilt and enlarged during the year. This is particularly true in San Francisco, Oakland and other thickly populated centers where the growth of load has been centralized. A total of 48,955 KVA in 60 KV transformer capacity has been added to the system and 50,235 KVA in 11 KV substations.

From an operating standpoint the year 1924 was a most strenuous one. The unprecedented shortage of water at the various hydro plants, together with the increased irrigation and other power demands incident to the shortage, taxed the system to its utmost to supply. Starting the summer with storage reservoirs not more than two-thirds filled and with less snow in the mountains than there has been since the inception of the hydro-electric industry in this state, it was necessary to reverse our normal conditions by operating power steam plants at full load from February 25th, 1924 right through the summer until the stream flows began to pick up after the storms on October 5, thus enabling us to hold in reserve such stored water as we had to supplement the natural flow of the streams and thereby making up at the hydro plants the deficiencies in the steam plants. Not only was it necessary to carry an unusual amount of load on our own steam stations but it was necessary to press into service practically every available steam plant irrespective of condition, size, cost of operation, etc., to help carry the load.

The average load on the system in 1924 was 214,835 kilowatts, an increase of 9 per cent over 1923. The peak load was 343,701 kilowatts, an increase of 12 per cent over the preceding year.

In 1923, 75 per cent of the energy deliveries to the system came from our own hydro-electric plants; 16.5 per cent from our own steam plants and 8.5 per cent was purchased from other companies. In 1924, due to the shortage of water, our hydro output was reduced to 53.7 per cent of the total; steam increased to 36.9 per cent and purchased power increased to 9.4 per cent.

As indicating the dependability of flow of Pit River and its tributaries during years of low precipitation and the value of plants on those streams from a power production standpoint, it is interesting to know that during the past year practicaly 50 per cent of all of our hydro-electric power came from the three operating plants on Pit River and Hat Creek.

The following hydro-electric and steam electric plants were operated in the "Pacific Service" system during 1924:

HYDRO PLANTS

	Horsepower
Alta, Placer County	2,681
Bullard's Bar, Yuba County	10,891
Centerville, Butte County	8,579
Coal Canyon, Butte County	1,340
Coleman, Shasta County	20,107
Colgate, Yuba County	20,878
Cow Creek, Shasta County	2,011
De Sabla, Butte County	17,426
Deer Creek, Nevada County	7,373
Drum, Placer County	50,268
Electra, Amador County	26,810
Folsom, Sacramento County	4,022
Hat Creek, No. 1, Shasta County	16,756
Hat Creek, No. 2, Shasta County	16,756
Halsey, Placer County	16,756
Inskip, Tehama County	8,043
Kilarc, Shasta County	4,021
Lime Saddle, Butte County	2,681
*Phoenix, Tuolumne County	2,513
Pit No. 1, Shasta County	93,834
South, Tehama County	5,362
Spaulding No. 1, Nevada County	5,027
Spaulding No. 2, Nevada County	1,340
*Spring Gap, Tuolumne County	10,054
*Stanislaus Tuolumne County	45,576
Volta, Shasta County	8,378
Wise, Placer County	16,756
Total Hydro	426,239

STEAM PLANTS

San Francisco	85,791
Oakland	44,906
Sacramento	23,459
*North Beach (San Francisco)	36,193
Total Steam	190,349
Total Hydro and Steam	616,588

*Leased properties.

The company's electric distribution facilities necessary to supply the 378,751 consumers connected to the system include 3,065.09 miles of high tension lines, 8,962.12 miles of overhead distribution lines and 158.66 miles of underground distribution lines; total mileage of lines 12,185.87.

There are 46,077 transformers connected with the distribution system having an aggregate capacity of 565,294 kilowatts.

DIVERSITY OF INDUSTRIAL UTILIZATION OF GAS

By Pacific Gas and Electric Company Consumers

TYPE OF INDUSTRIES	NO. OF SUCH USERS	PRINCIPAL APPLICATION	ANNUAL USAGE IN CUBIC FT.
Shipbuilding	10	Metal Treating	20,538,600
Paint and Varnish	28	Paint and Varnish Processing	5,883,600
Federal and Municipal	111	Water Heating	38,126,800
Paper, Wood, Leather, etc.	109	Seasonal Material	20,442,200
Oils, Drugs, Chemicals, etc.	95	Processing	35,362,700
Telephones and Telegraphy	29	Stand-by Gas Engines	15,354,300
Railroads	65	Metal Treating	35,546,600
Institutions	339	Cooking and Water Heating	85,510,600
Hospitals	117	Water Heating, Cooking and Sterilizing	74,376,700
Restaurants	1,589	Cooking and Water Heating	800,711,600
Hotels	316	Cooking and Water Heating	133,803,200
Automobiles	433	Heat Treating and Vulcanizing	73,487,800
Poultry Raising	45	Hatching and Brooding	10,644,700
Glass	25	Bottle Making	59,956,100
Sheet Metal Products	42	Heating Machines	53,094,600
Steel and Iron Products	252	Metal Treating	66,802,600
Electrical Products	77	Metal Treating	29,695,500
Iron Foundries	20	Rubber and Paint Treating Core Ovens	5,380,200
Brass, Copper, etc.	76	Metal Treating	24,984,500
Printing	149	Type Melting and Drying	93,068,400
Vegetables, Fruits and Food Products	91	Cooking and Preserving	29,580,200
Meat, Fish, Food Products	135	Cooking and Preserving	38,766,200
Bakeries	489	Baking	226,851,900
Candy	214	Steam Kettles and Cooking	101,513,800
Coffee	46	Roasting Coffee	100,739,900
Textiles	59	Steam and Dye Vats	22,941,900
Industrial Space and Water Heating	187	Air and Water Heating	13,978,600
Laundries	280	Ironing and Washing	79,777,700
Dyeing and Cleaning	222	Dye Vats and Steam Cleaning	34,831,900
Varied Industries	392	Miscellaneous	51,756,600
Total number of users....	6,042	Total Annual Usage (in cubic feet).....	2,384,510,000

Gas Department Reports The Most Active Year of Its History

A review of the activities of the department of Gas Construction and Operation for the year 1924 shows this year to have been the most active period in the history of the department. Due to the more general use of gas for all purposes and, also, to the rapidly increasing rate of population in all the cities and communities receiving gas service, our production department was required to manufacture seventeen billion seven hundred million cubic feet, an increase of one billion, nine hundred million cubic feet or twelve per cent over the previous year. The gas manufactured by this department represents three and eight tenths percent of the total manufactured gas produced in the United States last year, while our increase in gas sales for the year equals eight percent of the total increase in manufactured gas sales for the Nation.

The Production and Distribution Departments were hard pressed to meet the rapidly increasing demands for gas in all of our districts and the Construction Department carried out the most ambitious program in its history. The more imporant work included the construction of five new gas holders, with a total storage capacity of approximately ten million cubic feet, and seven new oil gas generators with a total daily generating capacity in excess of twenty-five million cubic feet. This in addition to all of the necessary buildings, boilers, compressors and other auxiliary apparatus and gas mains necessary for the production, transmission and distribution of the increased volume of gas. The new gas generating capacity added during this year is equivalent to fifty percent of the total installed capacity of the entire Pacific Gas and Electric Company's system for the year 1916. Equipment of the latest design and most efficient operation is being installed in all plants and provisions made for future expansion as necessity may require. New plant installations are being reflected in better operating results and improved service conditions.



Gas Works at the Potrero, San Francisco. Liquid purification towers and purifiers. Boiler and generating plants in background.

The extension of our high-pressure transmission system was continued, the Peninsula line was extended to the San Jose Plant and supply established for the Peninsula territory from both the Potrero and

San Jose generating plants. This now provides a continuous high pressure system from San Francisco to Los Gatos, a distance of sixty miles. The San Rafael-Santa Rosa high pressure system was completed, so that now the San Rafael generating plant is supplying from Sausalito on the south to Sebastopol on the north, a distance of approximately fifty-eight miles. The Napa gas plant became inadequate to supply the increasing demands for gas and the high pressure line was laid from Vallejo, a distance of sixteen miles, supplying gas from that source and permitting the closing down of the Napa plant. The high-pressure transmission line was extended from the Sacramento plant to North Sacramento, a distance of six miles, and high pressure gas service rendered to this rapidly growing community. Wherever possible generating plants are being centralized on tidewater and high pressure transmission lines extended to the various communities. This has proven to be the most economical method of operation and also insures the best service to our consumers and makes possible the supplying of small communities with gas where it would be impossible to render service if separate generating plants were required.



Interior of new compressor building in course of construction at the Potrero Gas Works, San Francisco.



New lampblack separators at the Potrero Gas Works, San Francisco. Oil boat at the wharf unloading supply of oil for gas manufacture.

It required the services of twenty-two hundred employees and four hundred automobiles to carry on the work of this department. In excess of four hundred miles of pipe was purchased for the necessary extensions and replacements to increase the supply and render service to twenty-one thousand seven hundred and six new consumers. The production of the

gas manufactured for the year required the operation of forty-nine generators and the consumption of three million two hundred and sixty five thousand barrels of fuel oil.

The work carried on by the Research Department has resulted in development of two new processes of considerable value to the Gas Industry. A study is now being made of the possibility of refining crude benzol collected from the high pressure transmission systems and the use of this product as a motor fuel.

San Francisco Division—The increase in new gas consumers during 1924, a total of seven thousand six hundred and fifty-eight, represents the largest increase in any year since the consolidation of the various gas companies under the Pacific Gas and Electric Company banner. A very extensive home building campaign was carried on throughout the year and ninety-five percent of these new homes when completed were served with gas for cooking purposes. Seventy-seven percent had gas water-heating apparatus installed and more than twenty-five percent insalled gas appliances for heating. A large number of industrial consumers were added to our lines and this, in addition to the more general use of gas by practically all consumers, resulted in an increase in gas sales of ten percent.

The Distribution Department was called upon to strengthen main trunk lines and, also, make numerous extensions of mains in order to meet the increased demands for gas. The San Francisco gas distribution system now consists of eight hundred and sixty-five miles of pipe lines supplying one hundred and fifty four thousand consumers who used approximately seven billion cubic feet of gas during the year 1924.

In order to be prepared for the increased gas consumption, it was necessary to continue the construction program at the Potrero plant. During the year a three million cubic foot holder and two additional gas generators of ten million cubic feet daily capacity and all necessary auxiliaries, boilers, compressors and buildings were completed and placed in operation. In addition to the San Francisco requirements, it was necessary to provide generating and compressor capacity for the rapidly growing Peninsula territory which is supplied from this plant for a distance of approximately forty miles south of San Francisco. The peak day sendout of thirty-four million five hundred sixty five thousand cubic feet on December 19th, an increase of sixteen percent, was met without difficulty, as all the necessary installations had been completed and placed in operation before this date.

Construction work is now well under way on two additional gas generators and



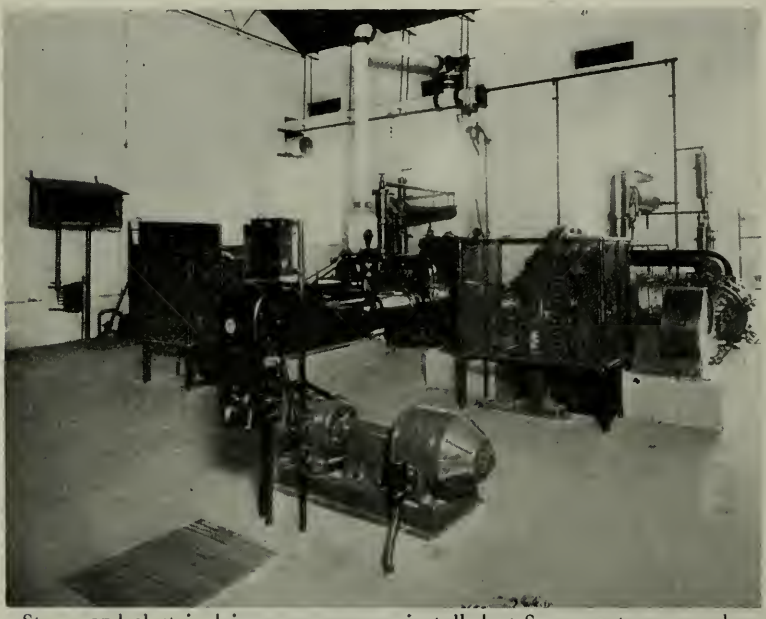
View of gas works from Market Street, Oakland.

the necessary auxiliary equipment to complete the Potrero generating unit. The completion of these new sets will provide this plant with eight of the latest improved oil-gas generators which will be able to meet a maximum day's demand of forty-five million cubic feet.



Liquid purification process installed at Oakland gas works. Absorber towers on left, actifiers on right.

East Bay Division—The residents of East Bay Division have become so convinced that gas is the ideal fuel for household purposes that most of the new homes are completely equipped with gas-burning appliances. The continuation of the extensive building program which has been under way for several years and the addition of a large number of new industrial consumers have required almost superhuman effort on the part of the Production and Distribution Departments to keep pace with the demand. Buildings are being erected in all sections of the Division and constant demands being made for new services. The Division laid sixty-eight miles of new mains, making a total of fourteen hundred and fourteen miles of pipe lines serving one hundred and fifteen thousand four hundred and eighty nine consumers, of which number seventy-six hundred and fifteen were added during the year. The sixteen inch high pressure trunk line was extended to the northern boundary of Berkeley and high pressure laterals laid to improve supply to this rapidly growing city. The semi-high pressure trunk system was extended in East Oakland and large numbers of consumers converted to semi-high pressure service, in preparation for the heating load. Gas sales for the Division totaled four billion, two hundred and seventy six million cubic feet, an increase of twelve percent over the previous year.



Steam and electric driven compressors installed at Sacramento gas works to supply high-pressure gas to Sacramento City, North Sacramento and Woodland.

Construction work at Gas Station "B" was continued from the previous year, one new sixteen foot generator of improved design was completed and placed in operation, twelve hundred horse power in additional boilers was installed, additional steam

driven compressor, exhauster and other auxiliaries in order to increase the capacity to twenty-five million cubic feet per day. This plant was called on to meet a peak day's sendout of twenty-eight million one hundred and eighty thousand cubic feet, on December 24th, which was an increase of forty percent over the previous peak demands. An additional generator, of five million cubic feet daily capacity, is nearing completion and with the equipment to be installed this year, the plant will be prepared to meet a peak demand of thirty-six million cubic feet next winter.



View of our company's gas plant at Fresno.

Sacramento Division—Home building operations continued without cessation throughout the year, hundreds of new houses were completed in the eastern and southern sections of the city. Most of the new homes are fully equipped with gas equipment as climatic conditions in this locality are ideal for gas fuel. An extensive paving program was carried on, necessitating the overhauling and replacement of small mains with pipe lines of larger capacity. Numerous extensions were made to supply new sub-divisions and one thousand and seventeen new consumers were added to the system during the year, making a total of sixteen thousand and sixty-one consumers. Gas sales for the year were seven hundred and fifty million cubic feet, an increase of twenty per-



San Rafael Gas Works picturesquely located in a setting of Marin hills.



This map shows sections of the "Pacific Service" territory in which gas service is furnished by high pressure from central points of manufacture. This high pressure transmission is rapidly doing away with local gas plants and is found to work not only for economy of manufacture and distribution but, also, for improved service to the consumer.

Five separate high-pressure systems are shown on this map. The most prominent is that stretching the length of the San Francisco peninsula from the central gas works at the Potrero in San Francisco to San Jose, a distance of forty-eight miles, and on to Los Gatos. Another high pressure system of about the same length, though not in so straight a line, is that by which the communities of Petaluma, Santa Rosa and Sebastopol on the one side and Sausalito and its environs on the other are served from the central plant at San Rafael. On the Oakland side of the bay is seen the high-pressure system radiating from the company's gas works in Oakland as far as San Pablo on the north and Hayward on the south. Other systems of lesser magnitude are those between Vallejo and Napa and Sacramento and Woodland, respectively.

cent over the previous year. The high pressure trunk line was extended to the rapidly growing North Sacramento community and five hundred new consumers rendered gas service.

The rapidly increasing demands for gas in this Division made necessary an extensive construction program at the gas plant. A three million cubic foot holder was completed and placed in operation, also a new oil gas generator was installed with all the necessary auxiliaries, with a daily capacity of three and one-half million cubic feet. The peak day demand of four million nine hundred and seventy-four thousand cubic feet, an increase of thirty-four percent was carried without difficulty and construction work is well under way on an additional generating set, boilers and other necessary apparatus in preparation for next winter's load.

Fresno Division—Building activities in this city were considerably curtailed during the past year with a result that the operations of the Distribution Department were not as extensive as during the past three or four years. Gas sales for the year amounted to six hundred forty-six million cubic feet, an increase of eight percent. The distribution system was strengthened by increasing the supply at many points and the replacement of small mains which had become inadequate.

Construction work was continued at the plant as this station was under capacity to meet the peak demands made by gas heating. A battery of new boilers, five hundred horsepower, was placed in operation. Other equipment installed included steam driven compressors, turbine driven booster, new type centrifugal exhauster and new station meters. Construction work on the new fifteen foot oil gas generator is nearly completed, this unit having recently been placed in operation. The Fresno plant is undoubtedly the best appearing plant in the system and with the completion of the work now under way should be able to capture the trophy for cleanliness and good housekeeping.

San Jose Division—Home building was continued at a very active rate in this division. Fifteen hundred new consumers were added to the mains and gas sales totaled five hundred ninety-five million cubic feet, an increase of nine and one half percent. The extension of the high pressure trunk line from Sunnyvale to San Jose and the establishment of an additional source of supply from the San Jose Gas Works have improved pressure conditions in the entire Redwood Division. The completion of this high pressure trunk system from San Francisco on the north to Los Gatos on the south makes this one of the most extensive high pressure transmission and distribution systems of manufactured gas in the Country. The Redwood District, receiving its gas supply from this high pressure system, is one of the fastest growing sections in the Pacific Gas and Electric Company's territory. Two thousand one hundred eighty-four new consumers were added to the lines in this district and gas sales totalled seven hundred and five million cubic feet, an increase of approximately twenty-five percent.

A large amount of construction work was required to prepare the San Jose generating plant for the additional load caused by the completion of the high pressure trunk line and, also, to meet the increased demands for gas in San Jose and adjoining territory. A three million cubic foot holder was completed and placed in operation. A new fifteen foot gas generator was installed in addition to the necessary auxiliary apparatus, scrubbers and lampblack separators. The plant was in good condition to meet the winter load and carried without difficulty the peak day demand of four million and thirty eight thousand cubic feet, an increase of forty-nine percent.

North Bay Division—The transmission lines were tied in and the necessary generating equipment at San Rafael was completed in April, making it possible to shut down and dismantle the Santa Rosa generating plant. This made the San Rafael plant the only source of gas supply for the territory extending from Sausalito on the south to Santa Rosa and Sebastopol on the north. A total of thirteen thousand four hundred and forty five consumers, of which number thirteen hundred and fifty-four were added during the year, used a total of four hundred three million, eight hundred thousand cubic feet of gas, an increase of approximately fifteen percent over the previous year. A five hundred thousand cubic foot holder was placed in operation at Santa Rosa to insure adequate reserve supply at all time.

The installation of this central generating

plant and the transmission of high pressure gas for long distances to serve a number of cities and communities marks another step in the progress of the gas industry.

In the Vallejo District the high pressure trunk line was extended to Napa and supply established from the Vallejo Plant. This permitted the closing down of the Napa generating plant which had become inadequate to meet the increasing demand. It has been found more economical to shut down smaller plants wherever possible and supply gas by means of high pressure transmission from the larger generating stations. The combined sales for Napa and Vallejo districts totalled approximately one hundred eighty-one million cubic feet, an increase of eight and one-half per cent.

Marysville Division—The demand for gas has continued to increase at a very rapid rate in Marysville and Yuba City. The gas sales for the year totalled seventy-one million cubic feet, an increase of eighteen and one half percent over 1923.

Construction work was rushed on the new plant in order to be prepared for the winter load. The new generating set was placed in operation early in December and carried a peak day load of four hundred and seventy-two thousand cubic feet, an increase of thirty-three percent, without difficulty. This plant now has a capacity of six hundred thousand per day and with the completion of work now under way will be a model gas plant.

Chico Division—Gas continued to be in demand in this thriving city. Sales increased approximately thirteen percent during the year and the maximum day's sendout was three hundred and seventy three thousand, an increase of thirty-eight percent over the previous year. Additional scrubbers, lampblack separators and an exhauster were installed at the generating plant. Plans were completed and contract let for the erection of a new two hundred thousand cubic foot holder on a site provided for that purpose.

Oroville Division—Additional compression tanks were installed in this plant to increase the gas storage capacity and with a slight modification in generators the plant was able to carry the winter load without difficulty. A number of extensions were made to supply new consumers and improve supply and pressure conditions.

Colusa Division—A few extensions of the gas mains were made to supply new consumers and improve pressure conditions. The Colusa Plant had a novel experience last winter. During a particularly cold morning the gas main leading to the storage holder became frozen and it was impossible to operate the plant for one hour while the main was being thawed out.

Grass Valley Division—Due to the general improvements in the mining situation the demand for gas in Grass Valley and Nevada City showed an increase of nineteen percent for the year. This required the installation of additional purifiers at the gas plant and made necessary the construction of a storage holder of one hundred thousand cubic feet capacity. The erection of this holder is now well under way and completion is expected by July in time for the peak load demand.

Redding Division—This division continues to show a remarkable increase in gas sales. The gas sold during 1924 showing an increase of two hundred and fifty percent over the sales of 1920. Plans are being prepared for the future expansion of this plant in order to meet the rapidly increasing demand.

West Side Division—Red Bluff gas sales increased sixteen percent for the year and the generating plant was called upon to meet an increase in peak day's sendout of sixty-two percent caused by unusually cold weather. Gas sales in Willows increased approximately ten percent.

The total generating capacity of our sixteen gas plants was 83,480,000 cubic feet as against 68,000,000 cubic feet capacity for 1923. The total of all peak day send outs was 81,738,200 cubic feet against 64,000,000 cubic feet for 1923. These figures again indicate the care exercised in developing generating capacity and auxiliaries just far enough in advance to take care of the growing demand, without waste of capital investment.

To supply this amount of gas required 3,833 miles of gas mains of various sizes from 2 inches to 36 inches, both high and low pressures, varying from 1/7th of a pound to 85 pounds.

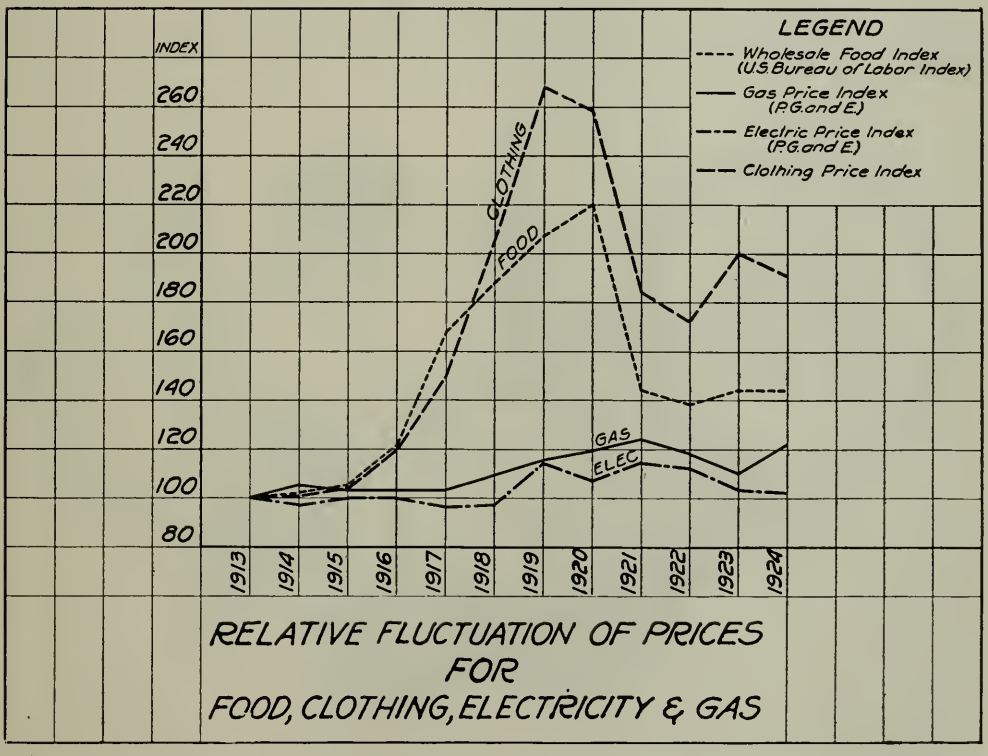
The increase in gas sales over 1923 was 1,602,683,200 cubic feet, or 11.72 percent increase, as against an increase of 10.69 percent for 1923.

The Modest Cost of Light and Heat

That the charges for service rendered by public utilities is the smallest part of the expenditures made from the average man's income is shown by a survey made recently by the Society of Electrical Development.

According to the figures 45 per cent of the income is spent for food, 16 per cent for rent and taxes, 14 per cent for entertainment and charities, 12 per cent for clothing and 7 per cent for miscellaneous. Of the remaining 6 per cent spent for some of the essential things of modern life, the survey shows that 1.03 per cent is spent for electricity and 1.08 per cent for gas.

Clothing and food show a very high increase in cost from 1913 to 1919 and 1920, respectively, while electricity and gas show a very much smaller increase compared to other commodities. The cost of clothes increased 170 per cent above normal at the maximum point and of food 120 per cent, while the cost of gas increased only 22 per cent at the maximum and of electricity 15 per cent.



The cost of electricity shows a gradual decrease from the peak. The relative cost of gas shows an upward trend in 1924; this is due to the fluctuation in the price of oil which represents a large portion of cost in the manufacturing of gas. The State Railroad Commission recognized this fact in 1921 after an exhaustive investigation. Basic rates were established and the changes in the price of oil are followed by changes in gas rates.

Under the Railroad Commission's plan of automatically adjusting gas rates when oil prices change, consumers get the immediate benefit of reductions in oil prices and the company is protected from losses due to increases in oil prices.

Most people spend more for tobacco, candy, picture shows and other miscellaneous items than they do for all of the utility service combined.

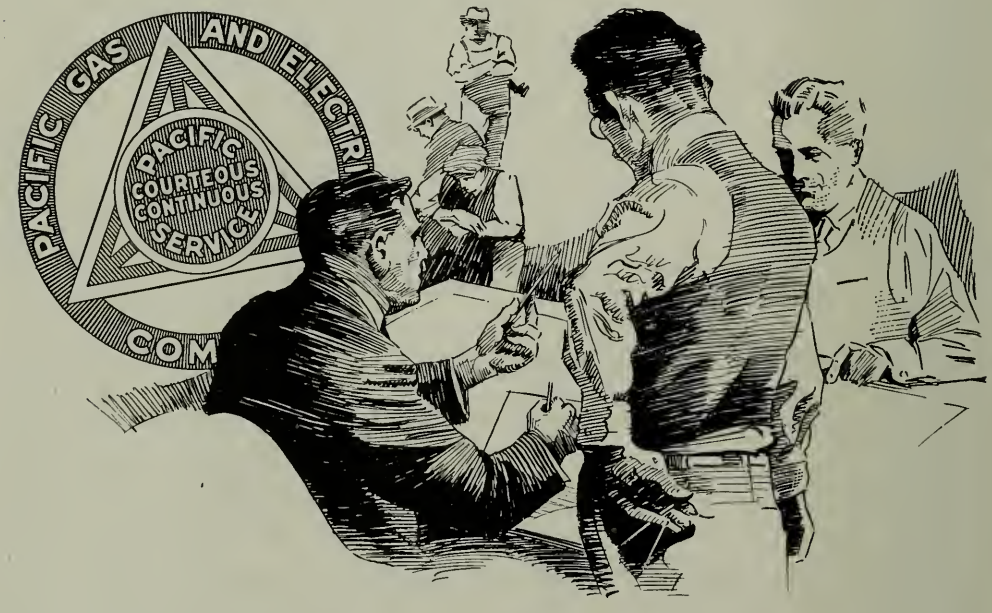
The Sales Engineer of "Pacific Service"

WITHOUT cost, expert advice on the efficient use of gas or electricity in any city served by "Pacific Service" is at the command of manufacturers and others using our commodities.

The Sales Department of the Company is organized to render this service. They will make a study of your individual problem, arrange the most efficient layout of equipment, and will give you complete information on any use of gas or electricity.

In recent years, uses have been developed for gas and for electricity heretofore thought impractical on account of the cost. Many manufacturers have found that it is not the cost of a fuel which is the deciding factor, but the over-all cost of production per unit of product. The cleanliness, convenience, and ease of control of gas and electricity, make them economic and superior for many uses.

Our Sales Engineers are familiar with modern practice in hundreds of industries, and before determining your process, irrespective of past experience, secure their advice which comes to you without cost and for the asking.



The Company offers this service for three reasons:

1. It wants its customers to use its commodities in the most economic way in order that they will be satisfied customers.

2. The Company is eager to extend service wherever possible, and knows that the customer must be shown reasons of economy and convenience and superiority before he will use these commodities.

3. We hold ourselves out to render a measure of service in upbuilding the community, and information is always available to those who ask for it without obligation.

Public Relations, Service and Sales Activities

During the year effort was continued to have each employee of this Company feel that his or her attitude and action reflected Company policy. The campaign conducted has produced most satisfactory results.

At the close of 1923 a plan of employee co-operation was instituted and carried on throughout 1924. Employees are furnished books of prospect blanks with the request that report be made of any complaint or prospect for new business which might come to their attention.

Periodical meetings were had with our 11,000 employees throughout the year to give them first hand view of our problems and successes.

In general the effort put forth to have our position understood and to fraternize with all those with whom we come in contact for a better understanding of our position, has brought us into very close harmony with our customers.

An effective policy of newspaper advertising was carried on through the year, which with our news service, has enabled us to present our problems to the public.

During the year five regular scheduled trips were made to Company property on Pit River. These educational inspection trips are conducted each year to acquaint men representing civic and industrial activities, with the type of development work carried on by this Company. Attendance on these trips were 583.

In addition to the five major trips, Division Managers conducted smaller parties to this development, there being 18 such trips made with a total attendance of 479, or a total for all trips during the year of 1062. Close observation proves that these trips have impressed the visitors with a better realization of what public utilities have accomplished and of the important part they are taking in the State's development.

As a means of measuring the quality of our service and as a means to measuring our public relations, a study of the number of complaints made to the Railroad Commission during the year shows that for every 10,000 consumers we received 3.51 complaints as against 3.74 for 1923; 3.99 for 1922, and 5.8 for 1921. This gradual decrease again shows the effect of our efforts to improve our relations with our consumers, a comparison most gratifying.

Sales Department—The company is now serving 397,000 electric consumers and 365,000 gas consumers, located in widely scattered territory which embraces thirty-eight counties of California and extends from Redding in the north to Fresno in the south. The sales force is distributed among the twelve territorial divisions of "Pacific Service," each division sales manager in charge reporting direct to the manager of his division. Each division sales manager is in charge of an organization of specialists highly trained in their respective lines of endeavor. In establishing this organization the company is following the modern idea of decentralizing the immediate control while centralizing policy management. All sales management policies are developed, planned and executed under the direction of the general sales manager.

The sales of gas and electricity to our consumers in 1924 showed highly satisfactory increases in every division. Sales of electricity to our consumers established a record mark of 11.7 percent increase. East Bay and San Jose Divisions recorded the greatest percentages of increase, while San Jose and Shasta made the best gains in numbers of consumers. Our sales activities covered all lighting problems, domestic and commercial, also sales of power for industrial and agricultural purposes and electric transportation.

The primary policy of the company is to sell electric energy, and it prefers to leave the merchandising of equipment in the hands of contractor-dealers and other merchants wherever such distribution is adequate and satisfactory to the requirements of the consumers and the industry. At the present time the company has on its lines

6,622 electric ranges and 3,208 electric water-heaters, the majority of which were sold by dealers; of these 1,356 electric ranges and 538 water-heaters represent the addition to our lines as a result of our activities in this direction during 1924.

Our gas sales showed an increase of 11.7 percent over the system as a whole, the large increases and the best gains in numbers of consumers being recorded by Shasta Division. The hotel and restaurant fields were exploited and during the year over five hundred large jobs were closed. The value of gas as an industrial fuel is being recognized to a greater extent every year, and the company employs highly trained specialists in this department of its sales activities whose business it is to place themselves at the disposal of the prospective consumer with expert advice concerning the utilization of gas in technical processes. During 1924 over six hundred large industrial gas installations were made.

Except in rare instances appliance sales are not handled by the company, due to its non-merchandising policy, but the company cooperates in every possible way with gas appliance dealers and house-heating equipment dealers in the sale of appliances. To effectively carry out this work the company is an active member of the Gas Appliance Society where company's representatives and dealers get together on an equal footing and explain their problems. The result being harmonious co-operation of all gas sales forces. The success of this form of merchandising policy is shown by the reports of the gas appliance dealers in our territory which show that the total value of gas appliances sold by them during the year 1924 was approximately $6,000,000, or an increase of twenty-five percent over 1923. Statistics show that the sales of gas per consumer increased 3.07 percent over the previous year.



Specimens of Company advertisements.

The total number of consumers served as of December 31st, 1924, was as follows:

Electric	378,751,	gain over 1923	30,795
Gas	365,396,	" " "	21,706
Water	18,864,	" " "	 1,054
Steam	606,	" " "	 27
Tot.Con.	763,617,	Gain over 1923	53,582

Advertising and Publicity—The Publicity Department during 1924 handled all advertising publicity with its own forces, a departmental organization being perfected for writing of advertising copy, preparing art work, typography and necessary mechanical details.

Contact was maintained during the year with sixty daily, 167 weekly, three foreign language and twelve miscellaneous publications, or a total of 232 publications. The various types of advertisements produced and published included those classes as educational, or institutional, a personnel advertisement, featuring officers and employees of the company, gas sales advertisements and electric sales advertisements. Specimens of some of these advertisements are shown on an accompanying page.

The *P. G. & E. Progress,* which was initiated during the year 1923, was published monthly during the year for the purpose of giving reliable information regarding our business activities in the direction of service to the consumer.

The *Service Manual,* a guide to "Pacific Service," was widely distributed through our territory and elicited many favorable comments.

The company's large illuminated map showing the territory served, powerhouses, transmission lines, etc., was on display in the various division offices. Educational films were shown before civic, educational and social organizations. Lectures were also given in which the story of electric development in Northern California was given, illustrated by slides and motion pictures.



Some "Pacific Service" publications.

The Personnel of "Pacific Service"

Probably no branch of industry demands a higher type of employee than the branch whose business is serving the public. "Pacific Service" maintains its high standard because of this Company's recognition of that fact.

In order to attract and hold a high type of employee an organization must develop effective methods of handling employee relations. Employees must be carefully selected, opportunity for advancement must be offered, working conditions must be safe and pleasant, compensation must be equitable and the employee must feel secure from injustice or unfair treatment.

The Personnel Department of this Company was organized with those facts in mind. Some idea of the scope of its activities may be obtained from the following brief summary for the year of 1924:

During the year 20,323 applicants were interviewed by representatives of the department. Of this number 950 were placed with various departments of the Company after passing the required physical examination.

The Personnel Department arranged the transfer of 117 employees and the promotion of 65 in addition to furnishing advice and data which resulted in many cases in departmental transfers or promotions.

An analysis of all occupations in the Company has been practically completed. This analysis is serving as a basis of compensation and promotion studies, so that definite channels of promotion, together with equitable salary ranges may be determined.

Safety engineers are constantly at work eliminating unnecessary hazards and educating employees in accident prevention and first aid work.

Employees are safeguarded from exposure to contagious or infectious diseases through the employment of new help. During the year 13,063 applicants were given physical examinations and 501 rejected by the doctors.

The Personnel Manager is constantly called upon to adjust grievances both real and fancied.

In addition to these functions the department has been able to be of service in many ways to the organization as a whole. Temporary transfers of employees have been arranged in several instances to relieve emergency conditions. Various departments have availed themselves of the specialized data on file and the Personnel Manager has been instrumental in bringing several important questions of policy to the attention of the management.

Service records of all members of the organization are kept by the Personnel Department and 116 persons were, this year, awarded the blue and silver badges representing ten years of continuous service. There are now 1399 persons on the list with service of from ten to forty years.

Under the pension system established in 1916, $50,423.39 was paid out in pensions during the year, making a total of $325,-064.96 paid since the system was established.

The total amount expended for labor during the year was $19,198,268.84, an increase of $3,205,539.76 over the amount spent in 1923.

The average number of employees in 1924 was 9,900 and the average daily wage paid was $5.74.

"Pacific Service" Installed In New General Office Building

The close of 1924 saw the practical completion of our company's new general office building in San Francisco. Early this year the process of "moving in" started and ere this Year Book reaches its readers the building will be fully occupied.

It is proposed in a forthcoming issue of PACIFIC SERVICE MAGAZINE to treat of this building in descriptive fashion. Meanwhile, it may be said that our new "Pacific Service" home has more than realized expectations. Externally, it is a commanding figure among the imposing structures that go to make up the new San Francisco. As will be seen from the frontispiece in this issue the building stands out prominently among its companions on lower Market Street. From the standpoint of interior accommodations and comforts, the general offices which run from the ground floor to the roof of this seventeen story pile are spacious and airy, in addition to being suitably equipped. In a word, "Pacific Service" is proud of its home.

The distinguishing characteristic of construction work on this building was its remarkable rate of progress. The excavation at the site, always a work of no little magnitude and responsibility on lower Market Street, began May 18th, 1923, and was completed July 12th. Then came the pile driving, which took until the last of February, 1924. Next came the steel frame, of unusually heavy character, which shot up with almost incredible speed, and before passers-by on Market Street had time to absorb the details the terra cotta outside walls were in place, the inside walls in place and the work of plastering was in progress. Experts estimated that the general construction work progressed twenty per cent faster than any others in process at the time.

The company had the good fortune to select contractors who performed their work with more than average expedition and, besides, exercised foresight in overlapping subcontracts as far as possible and in ordering materials and equipment in adequate time to guard against delays. In addition, the company's purchasing, law and engineering departments, organized to deal with great construction problems, each contributed to the speed of the progress.

Systematic orderliness was another feature of the construction program. Each contractor was required to enter upon his work at the scheduled time so as not to interfere with the operations of those preceding him nor delay those following. For example, the superstructure concrete work was commenced as soon as the steel frame had been riveted to the sixth story. Similarly, the exterior terra cotta work at the fifth floor level was commenced as soon as the concrete had reached the twelfth floor. The plas-

tering work was started with the metal lathing completed five stories in advance. These intervals were generally maintained as the work went on.

Public traffic was interfered with as little as possible by construction operations at the site. The heavy foot traffic on the south side of Market was scarcely conscious that building operations were in progress so far as concerned any personal inconvenience. Unusual safety precautions were observed in conformity with the rulings of the State Industrial Accident Commission. Those precautions refer particularly to the hanging scaffold and safety appliances on construction hoists which carried men as well as material. The result was that, notwithstanding the inevitable hazards of certain portions of construction work of the kind, no major injuries were reported.

One of the greatest sources of unexpected cost in building construction arises from revisions of design after contracts are awarded. Extras of this nature not infrequently range as high as twenty-five per cent of the original estimate. This cost factor was almost entirely avoided in the P. G. & E. building through consideration of the assignments of floor space and carefully drawn furnishing plans, indicating the positions of partitions, doors, desks, telephones, every important article, in fact, of interior arrangement. These plans were all prepared under the supervision of the several department heads occupying space in the building and were subject to their approval in final form before being incorporated in the specifications and drawings.

The new building occupies the western half of the block on the south side of Market Street between Beale and Main. It contains 134,000 square feet of effective floor area. The architectural treatment has been held to the simplest lines consistent with good, modern design. The general expression of the exterior is classic, although the classic elements are modified to the end that some slight touch of Western atmosphere may be present. California bear and mountain sheep heads have, accordingly, been substituted for the conventional lion's heads of classic form. Over the main entrance is a plaque of allegorical design illustrative of the light, heat and power industry. The architects of the building were Bakewell & Brown of San Francisco.

The necessity for such a massive edifice as this forcibly illustrates the growth of our company in recent years. It was only in 1916 that the company completed an eight story headquarters building at 447 Sutter Street, adjoining the building at 445 Sutter Street which had been the "Pacific Service" headquarters in San Francisco for some few years. With the removal of the general offices of the company to the new Market Street building, the old headquarters on Sutter Street will be exclusively devoted to the uses of San Francisco Division, where all business of the company within the limits of the Western metropolis will be transacted.

PACIFIC GAS & ELECTRIC COMPANY

A California Corporation

Managed by Californians Operated by Californians

"PACIFIC SERVICE" REPRESENTS (AS OF DECEMBER 31, 1924)

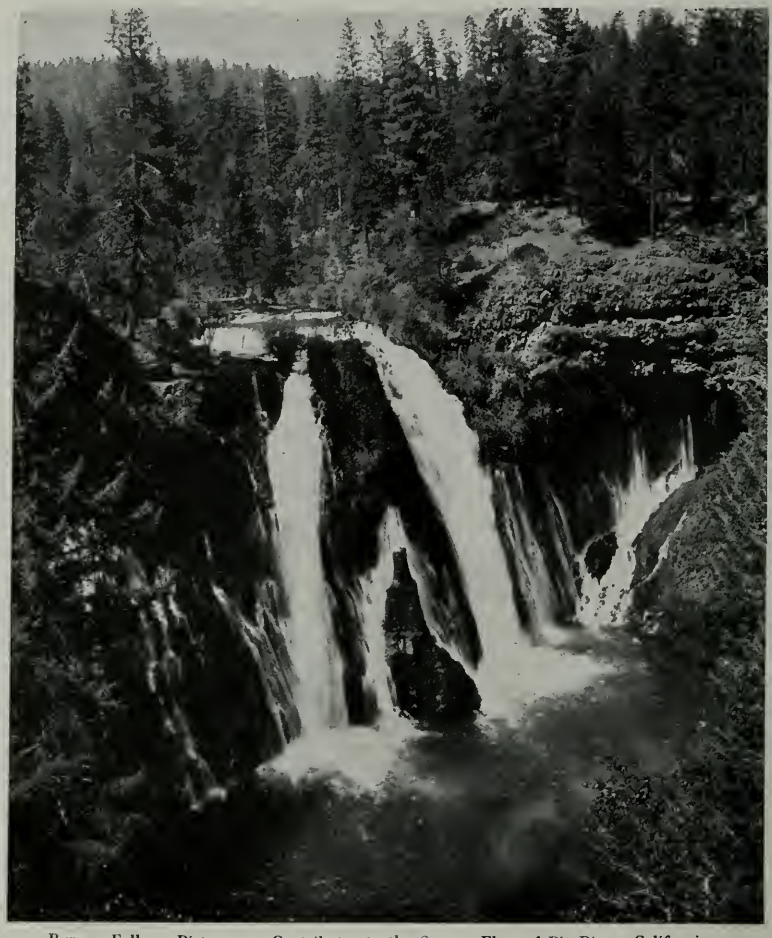
9,936	employed in all departments.
$249,000,000	capital invested in gas, electricity, railroads, steam, water and telephone plants.
59,000	square miles of territory in which it operates—an area greater than that of England and Wales.
31,859	stockholders.
38	counties of the State in which it transacts business.
763,617	consumers served with gas, electricity, water and steam.
2,158,000	people served in 38 counties, which is over 50 per cent of the State population.
291	cities and towns in which it supplies service directly and through other companies.
$19,198,269	annual wages paid employes in 1924.
$2,995,561	taxes, state and county, for 1924.
$927,117	taxes, Federal Government for 1924.
426,239	horsepower developed in 27 electric water-power plants.
190,349	horsepower developed in 4 electric steam plants.
616,588	total horsepower developed in 31 plants.
1,333,854,367	kw. hrs. sold. This is equivalent to the effort of 4,446,000 men.
15,277,477,500	cubic feet of gas sold in 1924.
17	gas plants.
12,186	miles of transmission and distribution lines. Greater than the distance between San Francisco and Colabar, West Africa.
3,833	miles of mains used in distributing gas. Greater than the distance between San Francisco and Santiago, Cuba.
1,100	miles of mains and ditches used in distributing water.
1,100	miles of track of street railway supplied with electric power.
70,340,568,100	gallons of water storage capacity in 109 lakes and reservoirs. This amount of water would supply the City of San Francisco at the present rate of consumption for nearly 5 years.
115,501	acres of land owned in California.
258	parcels of property owned in cities and towns.
6,672,014	barrels of California Oil used, year ending July 31, 1924.
178,744	horsepower in agricultural motors depending on "Pacific Service."
600,745	horsepower in mining, electric railways, manufacturing and other motors depending on "Pacific Service."
38,351	street lamps, gas and electric, lighted by "Pacific Service."
7,029,214	incandescent lamps nightly lighted.
1,367,501	horsepower connected to system.

PACIFIC GAS AND ELECTRIC COMPANY

General Office: 245 Market Street

San Francisco

Branches in all principal cities and towns of 38 counties of North Central California.



Burney Falls, a Picturesque Contributor to the Stream Flow of Pit River, California.

BURNEY FALLS illustrates most strikingly the character of the country whence flows the never-failing stream of Pit River. Through a myriad crevices seeps the water from the perpetual snows of mighty Mount Shasta and the Cascade Range. The drainage of immense lava areas gathers into tiny underground rivulets, combining to form vast subterranean reservoirs. The water rises to the surface in large, ever-flowing springs; is directed by man's effort to the great turbines of the Pacific Gas and Electric Company's Pit River power plants and there, without losing any of its original characteristics, without consuming its substance, it is harnessed to the service of mankind, turning the wheels of industry and bringing prosperity and comfort to the homes of thousands.

Herein lies a good parallel to the Company's financial operations. Idle money is like a stagnant pool. It helps no one. Money invested in this Company's securities is *usefully* and *profitably employed*. The savings of thousands upon thousands of workers form mighty reservoirs of capital, which is utilized to build power plants, dams, transmission lines and the innumerable facilities necessary to serve the people of California. This money pays, in the form of interest or dividends, a return to every one of the 75,000 investors in the Company's securities, at the same time losing nothing of its original value to the owners.

PACIFIC GAS AND ELECTRIC COMPANY

Stock Sales Department

245 MARKET STREET, SAN FRANCISCO, CALIFORNIA.

PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO



LASSEN PEAK. SOUTHERN PORTAL PIT RIVER WATERSHED

Vol 16 — JULY 1925 — No 5

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER	A. B. C. DOHRMANN	FRANK A. LEACH, Jr.
F. B. ANDERSON	JOHN S. DRUM	NORMAN B. LIVERMORE
CHAS. L. BARRETT	F. T. ELSEY	JOHN D. McKEE
W. E. CREED	D. H. FOOTE	JOHN A. McCANDLESS
W. H. CROCKER	A. F. HOCKENBEAMER	C. O. G. MILLER

OFFICERS

W. E. CREED	*President*
FRANK A. LEACH, Jr.	*First Vice-President and General Manager*
A. F. HOCKENBEAMER	*Second Vice-President and Treasurer*
D. H. FOOTE	*Third Vice-President and Secretary*
CHAS. L. BARRETT	*Assistant Secretary*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, Jr., Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney	LAW DEPARTMENT
C. P. CUTTEN, Attorney	RATE DEPARTMENT
R. J. CANTRELL, Manager	PROPERTY DEPARTMENT
E. W. HODGES, General Auditor	ACCOUNTING DEPARTMENT
H. T. TERRY	CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager	CREDIT AND STOCK SALES DEPARTMENT:
JOHN H. HUNT, Purchasing Agent	PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent	SUPPLY DEPARTMENT
E. G. McCANN, Manager	PERSONNEL DEPARTMENT
	ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT
O. W. PETERSON	Engineer of General Construction
E. H. STEELE	Engineer of Line Construction
F. R. GEORGE	Engineer of Operation
GEO. H. BRAGG	Engineer of Maintenance
	DEPARTMENT OF ENGINEERING
J. P. JOLLYMAN	Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER	Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE	Chief of Division of Civil Engineering
F. M. HARRIS	Chief of Bureau of Specifications and Estimates
O. A. KNOPP	Chief of Bureau of Tests and Inspection
	DEPARTMENT OF EXECUTIVE ENGINEER
F. C. PIATT	Valuation Engineer of Electric Properties
J. T. RYAN	Valuation Engineer of Gas, Water and Railway Properties
B. B. BECKETT	Rate Engineer
S. B. SHAW	Automotive Engineer
W. G. JACK	Manager Land Department
	GAS CONSTRUCTION AND OPERATION DEPARTMENT
FRANK WILLS	Engineer of Production
R. S. FULLER	Engineer of Distribution
HARRY J. SMITH	Engineer of Construction
	PUBLIC RELATIONS AND SALES DEPARTMENT
R. W. ROBINSON	Assistant to Vice-President in Charge of Public Relations and Sales
DON C. RAY	Manager Bureau of Public Relations
N. R. SUTHERLAND	Manager Commercial Department
H. M. CRAWFORD	Sales Manager
R. T. STEPHENS	Manager Electric Sales
FORREST U. NAYLOR	Manager Gas Sales
J. CHARLES JORDAN	Manager Publicity Department

W. B. BOSLEY, General Counsel

JOHN P. COCHLAN, Assistant to the President

F. S. MYRTLE, Editor-in-Chief Pacific Service Magazine

DIVISIONS AND MANAGERS

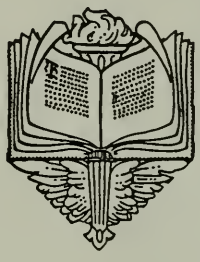
DIVISION MANAGERS		DISTRICT MANAGERS		HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION			Marysville
		J. V. KYLE	Colusa District	Colusa
I. B. ADAMS	DE SABLA DIVISION			Chico
H. M. COOPER	DRUM DIVISION			Auburn
		L. H. HARTSOCK	Nevada District	Nevada City
L. H. NEWBERT	EAST BAY DIVISION			Oakland
		J. H. PAPE	Berkeley District	Berkeley
H. C. ROSS	FRESNO DIVISION			Fresno
H. G. RIDGWAY	NORTH BAY DIVISION			San Rafael
		L. J. PETERSON	Petaluma District	Petaluma
		C. D. CLARK	Napa District	Napa
		C. D. CLARK	Vallejo District	Vallejo
		M. G. HALL	Santa Rosa District	Santa Rosa
E. W. FLORENCE	SACRAMENTO DIVISION			Sacramento
		C. W. McKILLIP	Sacramento District	Sacramento
		C. E. SEDGWICK	Solano District	Dixon
		J. W. COONS	Yolo District	Woodland
HENRY BOSTWICK	SAN FRANCISCO DIVISION			San Francisco
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION			Modesto
		W. E. ESKEW	Electra District	Jackson
		C. R. GILL	Modesto District	Modesto
		J. H. FAGG	Stockton District	Stockton
		CHAS. H. NOACK	Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION			San Jose
		W. T. KELLOGG	Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION			Redding
		M. P. WERRY	Pit River District	Fall River Mills
H. B HERYFORD	WEST SIDE DIVISION			Red Bluff
		STEPHEN GOIN	Willows District	Willows
		CHAS. HUGHES	Red Bluff District	Red Bluff

Pacific Service Magazine

Volume XVI — Number 5

Yearly Subscription, $1.50 — Single Copies, Each 15 Cents

Contents for July, 1925



THE POWER-HOUSE AT PIT THREE - - - - *Frontispiece*

PIT THREE DEVELOPMENT COMPLETED AND PLACED IN ACTIVE SERVICE - - - - - - 139

"PACIFIC SERVICE" IN ITS NEW HOME—
GENERAL OFFICE BUILDING A STRIKING TESTIMONIAL TO PROGRESS- - - - - - - - - - - - - 144
ARCHITECTURAL TREATMENT OF THE BUILDING - *John Bakewell* 147

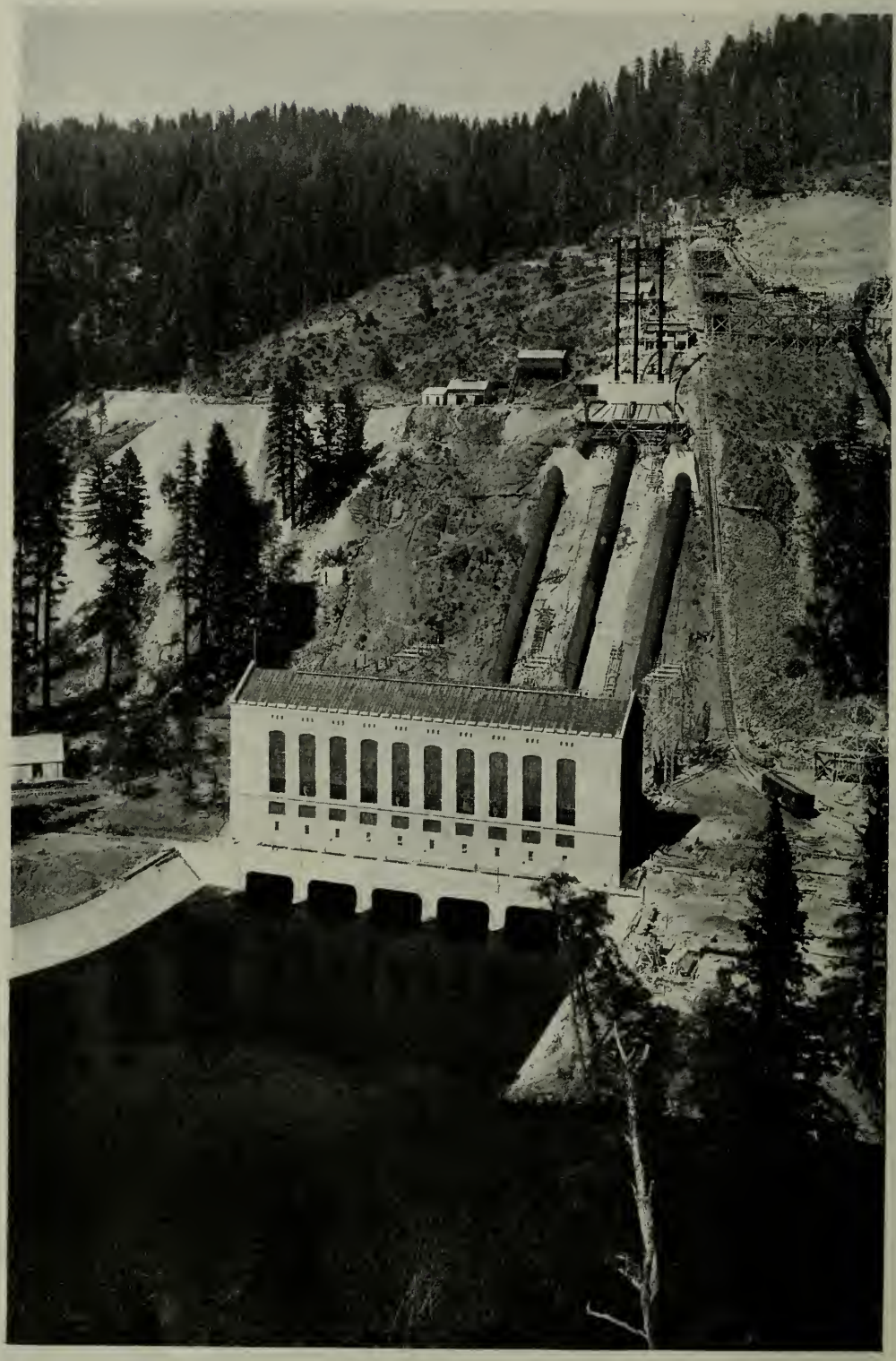
THE FINANCIAL SIDE OF "PACIFIC SERVICE" - - *A. F. H.* 152

EDITORIAL - - - - - - - - - - - - - 154

THE "PACIFIC SERVICE" ROLL OF HONOR - - - - 156

AN EMPLOYEES ASSOCIATION 7000 STRONG - - - - 158

HOW THE N. E. L. A. CAME TO SAN FRANCISCO—
HIGH LIGHTS UPON A CONVENTION THAT MARKED THE FORTIETH ANNIVERSARY OF A GREAT NATIONAL INDUSTRIAL ORGANIZATION - - - - - - - *F. S. Myrtle* 160



Pit Three power house—placed in operation July 18th.

PACIFIC SERVICE MAGAZINE

Volume XVI JULY, 1925 Number 5

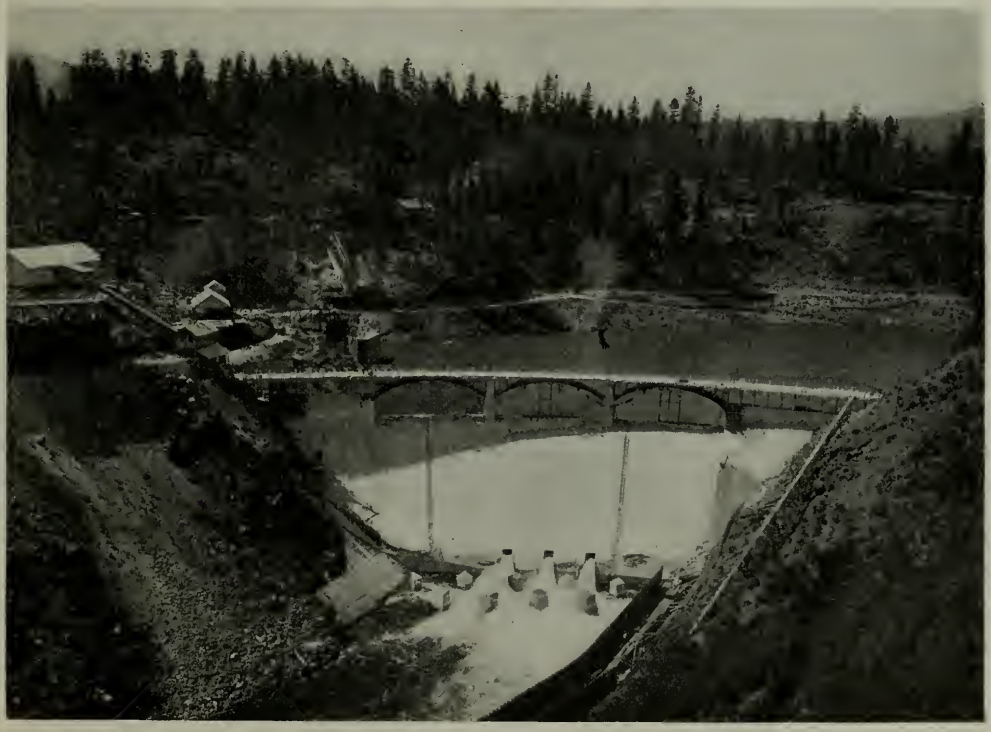
Pit Three Development Completed and Placed in Active Service

Pit Three development, the newest link in the "Pacific Service" hydro-electric chain. was placed in operation on the afternoon of Saturday, July 18th.

The opening ceremonies were attended by a party of company officials, headed by Mr. Frank A. Leach, Jr., first vice-president and general manager, and some two hundred newspaper editors ond publishers of northern California. The engineering departments of two leading universities of the State and the manufacturing concerns that furnished apparatus for the development were also represented. Miss Bernice Downing, editor of *Santa Clara Journal,* closed the switch that set the generators in motion.

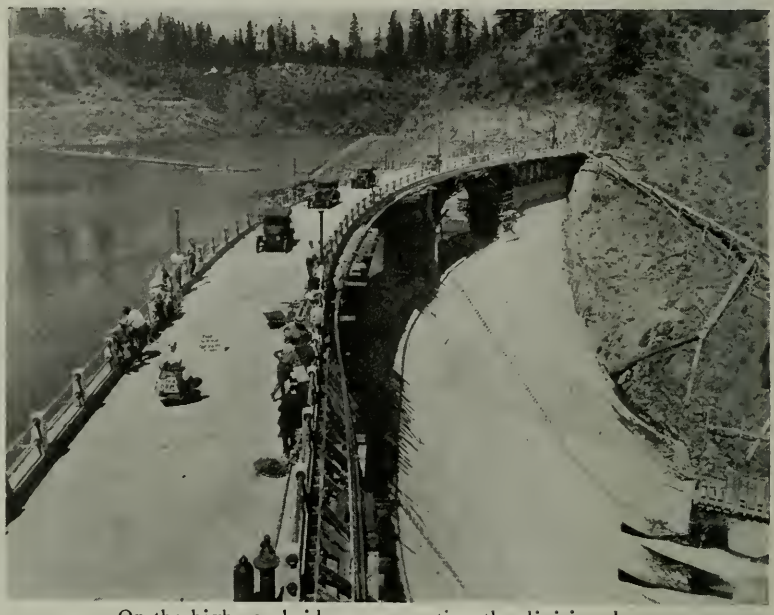
The party was conveyed to the scene by a special train leaving San Francisco on the evening of Friday, July 17th. At Davis and Redding visitors from points east and north of the bay region joined the train. From Mt. Shasta, in which name the station formerly known as Sisson has been rechristened, the way lay over the McCloud River railroad as far a Bartle and over our own company's extension from that point into the Pit region. A picnic lunch was served en route. On arrival at Pit Three the train ran past the diversion dam and headquarters camp direct to the powerhouse, where an assemblage of construction engineers, operators and others, with their wives and families, were gathered.

There was no delay. All was ready and in place. Mr. Leach opened the ceremonies with an address of congratulation and welcome. Speaking for the board of directors and the company's management he



Downstream face of division dam, showing highway bridge over the crest.

called attention to the prominent features of the new development and complimented the engineering forces highly upon their achievement. He spoke of the Pit River development generally and its reliability of service. He called attention to the fact that Pit Three was the first water-power plant to be constructed by the company under a Federal license, a portion of its territory being upon Federal lands. With the company operating under regulation by a State Commission there could be no question that the public rights were safeguarded and the public convenience cared for in every possible manner.



On the highway bridge surmounting the division dam.

Mr. Leach said that Pit Three would add more than twenty per cent to the company's electrical output and that the company was prepared to send that additional output into its system with confidence that it would be soon absorbed by the rapid growth of the section of California fed by the transmission lines.

"We aim to go forth with the State and as other plants are needed we purpose to build them," said Mr. Leach.

Some of the men responsible for the success of the undertaking were then introduced. First came Mr. A. H. Markwart, vice-president in charge of the department of engineering upon whose plans the development was constructed, and he, in turn, introduced prominent officials of his department, including Mr. J. P. Jollyman, chief of the division of hydro-electric and transmission engineering, and Mr. I. C. Steele, chief of the division of civil engineering. Next came Mr. P. M. Downing, vice-president in charge of electrical construction and operation, who, in turn, introduced officials of his department, including Mr. O. W. Peterson, engineer of general construction, Mr. E. H. Steele, engineer of line construction, Mr. Grover Green, field engineer, and Mr. G. H. Wehrle, superintendent on the job.

Then Miss Bernice Downing was introduced as the representative of the visiting journalists. All being ready, Miss Downing took her stand at the switch and in another instant the giant generators began to move. Pit Three was in operation.

After an inspection of power-house and surge-chamber the party proceeded to headquarters camp where after dinner an entertainment was held in the community hall. Mr. Leach introduced Mr. R. E. Fisher as master of ceremonies. The physical and engineering details of the Pit River development were explained, in turn, by Messers. Downing and Markwart, and the financial operations by Mr. A. F. Hockenbeamer. Motion pictures and lantern slides illustrated the talks. Then came Mr. Irving Martin, of *Stockton Record,* a former member of the State Railroad Commission, with an address in which he complimented the utilities of the present day upon their success which he thought was largely due to their up-to-date policy of co-operation with the public they serve. Dr. Harris J. Ryan,

professor of electrical engineering at Stanford University and whose valuable assistance had much to do with the solution of the high-voltage transmission problem, spoke upon the value and fulfillment of visions as applied to present-day achievement. Professor C. L. Cory, dean of the college of civil engineering at the University of California, gave an interesting talk upon the value of team work in all modern undertakings.

After breakfast the following morning the party assembled upon the highway bridge surmounting the diversion dam. There an interesting ceremony was performed when Mr. C. L. Cutten, head of our company's rate department, spoke in terms of affectionate admiration of one who had gone before but whose memory would ever be cherished by the men and women of "Pacific Service." At the conclusion of his talk Senator Cutten cast rose petals upon the waters beneath the bridge and in the name of the company christened the newly-made reservoir Lake Britton.

Mr. O. W. Peterson, general construction engineer, spoke briefly of the engineering features of dam and tunnel, after which the party inspected the tunnel intake. All assembled at headquarters for luncheon. On behalf of the visiting newspaper men Mr. Clem Bradshaw, editor of *Sunnyvale Standard,* read an original humorous poem, and Mr. M. F. Cochrane, of *San Rafael Independent,* expressed sincere appreciation of the company's courtesy in enabling the press of northern and central California to obtain first-hand information of all the company's activities in the way of progress and development. The entire party left camp in the afternoon and reached home the following morning.



Miss Bernice Downing, who set the great plant in motion.

This, the second major development constructed by our company upon the Pit River, was completed within the estimated time and, also, within the estimated cost. Its construction was remarkable for the mathematical precision with which the three leading features, namely, the diversion dam, the tunnel and the powerhouse, were carried to completion within a few days of one another, an example of co-ordination that reflected great credit upon the construction forces.



Upstream side of dam. The crowd at the christening.

Construction work started in May, 1923, with an extension of the Pit River railroad for purposes of transportation of material and supplies. From a junction with the

main line at Clayton Valley the road was laid along the most direct route, passing a hundred feet in elevation above the crest of the projected diversion dam and about ninety feet below a headquarters camp which was established upon the summit of the bluff overlooking the Pit. From the dam site to the site of the power-house, a distance of about five and one-half miles, the railroad follows the contours of the stream, toward the end of its journey sloping gradually to the water's edge. This road was not quite so simple an undertaking as the first stretch of line from Bartle to Pit One, for the reason that it travelled over the rougher country of the river gorge; nevertheless, though the first spadeful of earth was not turned until May 1st, nearly five miles of road reaching as far as Pit Three camp had been completed by July, and before the end of the year the entire distance had been traversed and freight was delivered at the power-house site.



Youthful tests of a substantial structure.

In August, 1923, was started the work of tunnel-boring. This job differed from the tunnel work at Pit One in that it was found possible to divide it into sections. From the intake, which was located 300 feet upstream from the dam site, the first stretch was 8681 feet to Rock Creek, where a ravine 266 feet in width was crossed by reinforced concrete pipe upon concrete supports. From the far end of this next stretch was one of 4640 feet to an adit, where a tunnel 200 feet long was driven from the railroad to tap the main tunnel and so allow the work of boring to proceed at both ends of this section. From this point to the power-house proper was a stretch of 7648 feet. Altogether, then, the full length of the tunnel was 20,969 feet. The work of tunnel boring was carried on uninterruptedly. The progress record is as follows: Heading No. 1 was portaled August 5, 1923, heading No. 2 on December 9, 1923, and the two headings met December 11, 1924; heading No. 3 was portaled October 15, 1923, heading No. 4 December 1st, 1923, and the two headings met October 25, 1924; heading No. 5 was portaled December 1, 1923, heading No. 6 February 17, 1924, and the two headings met December 9, 1924. Then came the work of concrete lining the tunnel which was completed early in June, 1925.

In order to facilitate the work of placing the foundation of the diversion dam, there was constructed a temporary dam 500 feet upstream by which the waters of the river were diverted into a concrete flume which carried them to a point below the permanent dam site and so drained the river bed for construction purposes. The work of excavating the foundations of the permanent dam site started early in December, 1923; concrete was poured into the abutments in June of the following year and the dam itself was a practically completed structure in the early part of June, 1925. As before stated, the dam is 125 feet in height from foundation to crest, and 110 feet above the surface of the stream. It is a dam of "Ogee" type, of reinforced concrete, and is furnished with an apron on the downstream side which carries the water well away from the dam and so prevents any possibility of erosion. It measures 600 feet across and above the crest, on piers, has been

constructed a bridge over which the country road running from Redding to Bartle will cross the river. This has been made necessary by reason of the fact that Peck's Bridge, over which the country road formerly led, has been obliterated by the rising of the waters in the dam and the creation thereby of a forebay resevoir approximately ten miles in length and of 34,750 acre feet maximum capacity.

The work of clearing the site for the power-house was started early in December, 1923, and excavating the foundation shortly afterward. Concrete pouring began July 9, 1924, and was finished by the opening of June the following year. At the western portal of the tunnel the flow of water in the penstocks is regulated by a surge chamber, as at Pit One, and from this three penstocks convey the water down the 300-foot slope into concrete tunnels which cross a 155-foot stretch of flat into the power-house.

The power-house itself is of simple but imposing design, of modern construction in every respect. Its complete equipment consists of three turbines built by the Pelton Water Wheel Company of San Francisco, directly connected to General Electric generator units each of 27,000 kilowatt capacity. The high tension transformers and switches were furnished by the Westinghouse Company and are located outside the building.

Pit Three development, fully completed, is rated at 108,579 horsepower capacity, and in order to carry this additional power from the Pit some additions and reinforcements have been made in the "Pacific Service" electric distributing system. First of all, a double-circuit steel-tower line has been built from the power-house to tie in with the Pit One line at Hayne's Meadow, a point on the highway between Burney and Montgomery Creek. Then, substantial additions have been made to Vaca-Dixon sub-station. Originally the capacity of this was 133,000 horsepower in transformers and 40,000 kilovolt amperes in condensers. The transformer capacity has been enlarged to 200,000 horsepower and the condenser capacity has been doubled by the installation of what is said to be the largest synchronous condenser in the world, rated at 40,000 kilovolt amperes. At Vaca-Dixon station the power received from the Pit is "stepped" down from 220,000 to 110,000 volts for retransmission to other sub-stations at central points in "Pacific Service" territory.



Scene on Lake Britton, forebay reservoir at Pit Three development.

"Pacific Service" in Its New Home

General Office Building in San Francisco a Striking Testimonial to Progress of the Light and Power Industry

"Pacific Service" is now comfortably settled in its new home. The imposing seventeen-story building on the southeast corner of Market and Beale Streets, San Francisco, which now houses the general offices of the company, has been enthusiastically accepted as a worthy addition to the skyline of the reconstructed metropolis. In its achievement a long cherished dream has been fulfilled.



An imposing exterior.

Progress of construction has been noted from time to time in previous issues of PACIFIC SERVICE MAGAZINE. Considerable public interest was evinced in the building from the day when the excavation for the foundations was started. This continued throughout the heavy pile driving, intensified by the thought that this tall structure was being made to stand on a section of lower Market Street which in early days was covered by the waters of the bay. Next came the rapid growth of the steel frame which the passersby noted was of remarkably substantial character. From that point the building passed through the various stages of construction until, early in the spring, lights shining from windows on various floors denoted that the process of moving in had begun.

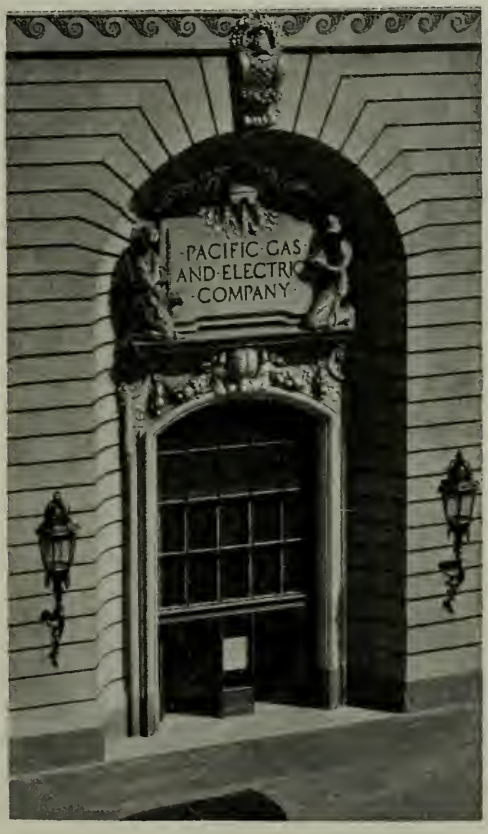
Members and friends of "Pacific Service" have found much to admire in this thoroughly modern structure, not only from the viewpoint of the company's relations with those outside but, also, from its adaptation to the company's internal needs.

Public convenience was carefully studied in the arrangement of space. On the ground floor are established those offices which have most frequent contact with the general public, the cashier and the stock transfer agent. Advantage was taken of the court area at the rear of the building for the construction of a roomy and well-ventilated auditorium, where lectures, moving pictures and entertainments of popular interest are programmed from time to time.

Above the main floor major consideration was given to the housing of the various departments in such manner as to bring those departments which have the closest company relation together. This is a refreshing relief from the conditions that prevailed through lack of space in the company's former headquarters and materially affects the efficiency and expedition with which the company's business is transacted. All of the general office departments are provided for, including the construction and operating departments for electricity and gas, engineering, public relations and sales, law, rates, ac-

counting, purchasing, property and tax, credit and stock sales, personnel, the department of the executive engineer, and the offices of the general counsel. All of these departments have comfortable and airy rooms at their disposal with reasonable provision for expansion. The very surroundings are such as to encourage the employee to put forth his best efforts.

Upon the fourteenth floor, at the strategical point in the building, are located the executive offices of the president, the first vice-president and general manager, the second vice-president and treasurer and the assistant to the president. The office of the third vice-president and secretary is situated apart, on the second floor, in closer proximity to those offices which report to him. There is a suitably equipped directors' room on the executive floor, where the regular meetings of those who control the larger affairs of the company are held.



The ornamental doorway.

The sixteenth floor is devoted entirely to the welfare and comfort of the employee. Here are found the women's rest rooms, the Pacific Service Employees' Association library and an extensive lunch room where coffee, tea and bouillon are served to employees free of charge. These are supplemented by lunches which the employee brings from home, or by box lunches, sandwiches and other articles of refreshment which may be had at moderate prices. This room has already been appreciatively patronized by several hundred employees daily and the service which it extends will undoubtedly be expanded in the future.

The architectural treatment of the building is described in an article following by Mr. John Bakewell, Jr., of the firm of Bakewell and Brown, who are to be credited with the architectural conception of the building. Even the layman is impressed by the beauty and appropriateness of the ornamental detail, both within and without the building. General approval has been given to the Western atmosphere which has been introduced in such a moderation as to preclude its becoming provincial.

For certain decorative features of the exterior Mr. Edgar Walter, well known sculptor, was responsible. The most prominent of these is the plaque which is set in the arch over the front doorway. In this the artist has carried out the idea of illustrating the Western power industry. There is a model power-house in the center and on either side an allegorical figure, one illustrating the production, the other the application of electrical energy.

Surmounting the arch one observes a cluster of Western fruits and flowers, and immediately below the plaque is displayed the traditional California grizzly. The character of the West is further symbolized by heads of California mountain sheep which are set over each of the thirteen arched windows in the ground floor of the building. These heads have been substituted for the conventional lions' heads so commonly found in classic architecture and, like the other allegorical figures described,

represent energy and vitality, noted characteristics of our Western manhood.

A striking feature of interior decoration is the cartouche upon the ceiling above the entrance hall. Here is displayed the "Pacific Service" emblem, with the legend, "Pacific Service, courteous, continuous," in a truly ornamental setting.

Occupation of the building was gradual. Some departments were accommodated quite early in February, but the executive offices did not move in until the middle of April. As a result, there was no special opening ceremony, no formal inspection by either officers, stockholders, or the general public. There was held, however, an interesting ceremony on the evening of April 21st, when the spacious auditorium on the ground floor of the building was made use of for the first time. On this occasion the radiotone portrait of the late Mr. John A. Britton, referred to in a previous issue of PACIFIC SERVICE MAGAZINE as having been subscribed for by members of the Pacific Service Employees' Association and intended as a gift from them to the company, was formally presented by the association to the company and as formally accepted by the company.

An assemblage of several hundred members and wellwishers gathered to express their approval of a touching tribute to the master builder so dearly loved by all in the "Pacific Service" family. Mr. A. U. Brandt, former head of the Pacific Service Employees' Association and chairman of the special portrait committee, presided and with a few opening remarks introduced Mr. W. D. Skinner, present head of the Pacific Service Employees' Association, who formally presented the gift. Mr. Skinner related that in the spring of 1923 the suggestion of a radiotone portrait of Mr. Britton to commemorate the approaching fiftieth anniversary of his service with the gas and electric industries had met with hearty response from the association membership. Subscriptions had been limited to twenty-five cents per head and there were 5,687 contributors on the roll. Unfortunately, Mr. Britton had not lived to celebrate his fiftieth anniversary, but the testimonial to his worth has been completed



Head of California mountain sheep.

and would hang upon the walls of the auditorium as an inspiration to the younger generation to profit by the noble example of their late leader's life.

In accepting the employees' gift on behalf of the company President W. E. Creed spoke most feelingly of the man whom he had known and admired so many years, who had devoted his life to the public service, and whose career served as an object lesson to all who would travel life's pathway toward the goal of achievement.

"He was a noble character with a great soul," said Mr. Creed. "He inspired friendships which endured forever in men's minds and hearts. No need then for you to tell me that this gift is from the depths of your affections."

A special program of music, both vocal and instrumental, formed a suitable setting to the presentation ceremony.

It remains only to say that the company's management extends a cordial invitation to the company's stock-holders and friends to visit the building as their convenience may permit.

With the removal of the general offices of the company to the Market Street building, the old headquarters at 445 Sutter Street has been assigned to the exclusive use of San Francisco Division, where all business of the company within the limits of the western metropolis is transacted.

Architectural Treatment of the Building

By JOHN BAKEWELL, of Bakewell & Brown, Architects.



Stock Transfer department on the ground floor.

While it is distinctively American in its construction, the high office building of today must have as its structural basis some traditional architectural style, unless the architect is to cast aside his heritage and rashly attempt to work out an entirely new design. A casual study of the great architecture of the world will show that no great building has ever been evolved which did not grow out of what preceded. New problems, new structural inventions, new materials and new ideas mould and change the architectural forms and motives, even change the entire spirit and effect of architecture, but always in a constructive and progressive manner, using and developing the forms and traditions that the preceding ages have produced.

At the same time, every building of merit has its own individuality, which is due in part to the personality of its architect, in part to the demands of the man or group of men for whom it is built, and largely to the peculiar requirements and needs of those by whom it is to be occupied. A large office building, if only on account of its size and importance, requires an architectural treatment worthy of its character.



The Auditorium, ground floor.

Experience has given more or less successful solutions of the office building problem. It has been shown that the simple grouping of a multitude of elements into a few divisions or parts of a composition is necessary to achieve that unity which is so essential if the building is to count as a single unit. One of the ways of grouping is the division of the building into a high and important base, a general shaft and, finally, a crowning motive. This is the scheme of composition

adopted in the Pacific Gas and Electric Company's building.

The base of the building runs up through three stories. This was a necessity of proportion in order to be in keeping with the neighboring building which runs through the first three stories. The entrance is placed in a large arched niche which runs up to the third story while the running motive of arched windows takes in two stories. The height of the first story and the fact that both first and second stories consist of large spaces make this a natural and effective arrangement.



Mailing room, stationery department.

The crowning motive, which in this building occupies the fourteenth and fifteenth stories, consists of an arcade of which we shall speak more particularly later. The executive offices are placed upon the fourteenth floor and other large spaces on the floor above, so that the large windows of this floor express the architecture and are suitable for these offices. The main shaft between the base and the crowning motive has been stripped of all ornament. It becomes a great pedestal for the columns and arcade of the fourteenth and fifteenth floors. By distributing the windows uniformly over the whole surface they take their place as mere incidents in the single mass, a means of giving texture to the shaft; they no longer count as separate units.

This simple treatment of the shaft furnishes a decided contrast to the base and the crowning motive. The base has deep reveals and, consequently, deep shadows, and it is colored by ornament, which though sparingly used yet counts because of its careful placing. The arcade at the top of the shaft is broken up so as to give a brilliant play of light and shade, while the varying planes and surfaces of the columns and walls give the impression of richness. Both base and arcade use arch forms, decoration and mouldings. The shaft, on the other hand, is entirely simple and devoid of ornament. Its lines are straight lines. The reveals of the rectangular openings are small. In fact, the entire



General construction department.

treatment is such as to accentuate simplicity in contradistinction to the more elaborate treatment above and below.

The treatment of the terra cotta wall surface in rusticated courses serves two very useful purposes, one practical and one aesthetic. Large blocks of terra cotta have a tendency to warp and twist in the process of making. The small grooves of the rustication break up the continuity of the surface and the wavy appearance that would be apparent, if the wall were absolutely of one surface, is lost. These small grooves form continuous lines entirely around the building, carrying from one side of each window or opening to the other, and are of great assistance in tying the masses together.



Private office of First Vice-President and General Manager F. A. Leach, Jr.

In this entire scheme there is perfect accord between the actual spaces and the architectural treatment, so that it has not been necessary to sacrifice either practical requirements to the architectural or to sacrifice the architecture to the requirements.

In the development of this architectural scheme an interesting method has been used in the designing of what we have called the crowning motive of the fourteenth and fifteenth stories. This consists of a large arcade with a Doric order. The cornice of this order becomes the cornice of the building and does not become so heavy as to destroy the scale of the building or to interfere with the lighting of the interior.

By breaking the entablature above the columns a very interesting play of light and shadow is obtained and each column becomes a buttress supporting in ornamental motive. This breaking of the cornice serves several purposes. It gives a termination to the top of the crowning feature which carries the line up in a series of pinnacles which enrich this feature without an excessive use of ornament; at the same time, it makes the proportions of this order more graceful.



The directors' room, fourteenth floor.

In a general way the composition was arranged to be in harmony with that of the adjoining building, while an effort was also made to have certain contrast to that building and to adopt a scale and mass which would by

contrast show the semi-public character of this public utility building.

The story of the power industry marks the entrance. It is framed in two massive figures by Mr. Edgar Walter who also made the keystones recurring over the first story arches. These keystones serve to carry the interest around the two facades and lead up to the central motive and its larger keystone.

The heavy band above marks the point of division between base and shaft just as does the band at the top of the main shaft of the building on which rest the columns of the crowning motive, dividing the shaft from the crowning motive.



Committee conference room on the fifteenth floor.

One other point of especial interest in the exterior treatment of this building is the method by which the pent houses, tanks and other necessary equipment have been concealed. In many recent buildings the necessary utility features of the roof have been concealed in belvederes or towers rising above the roof. In this particular building this treatment would have been quite difficult, as an effective tower requires a very large mass. Then, too, it was felt that as the neighboring building was already treated in this manner such a tower would have a tendency either to detract from the effectiveness of its neighbor or itself would suffer from the close proximity of the similar motive. For these reasons it was decided to construct a recessed roof story in which all pent houses might be successfully concealed. As the sixteenth story is set back for architectural reasons, there is a balcony or promenade around this story, a very attractive feature. The sixteenth floor is used for the employees' rest rooms, restaurant, and library.



Lunch room for employees on the sixteenth floor.

The interior plan is for the most part similar to that of any modern office building. The corridors are direct, spacious and well lighted. The offices are all very well lighted and are arranged in the usual manner except that a great many of the departments have large work-rooms in place of the offices. However, there are a few rather un-

usual details which may be of interest.

Since the first floor is most readily accessible, on it are placed those departments which are in closest touch with the public. The entrance leads directly into a large vestibule running parallel to the front of the building. At either end of this vestibule are found the entrances to the main departments of this floor. Directly in front of the entrance, at the center of and at right angles to the entrance vestibule, is the elevator lobby which is ample and well proportioned, and beyond the elevator lobby is the entrance to the general assembly room.

This makes an almost ideal arrangement, with the most important center directly in front and with the cashier's and transfer agent's departments to the right or left as one enters the building.



Entrance hall and elevators.

The vestibule and elevator lobby are constructed of Bedford stone, a warm grey buff. The treatment of these spaces is simple and dignified, the plain walls being enriched by the color texture and jointing of the stonework.

The typical floors from the second to the sixteenth stories all have the same general arrangements for taking care of the public. The large elevator lobbies are lighted by large windows opening on the southern court. As these lobbies are very spacious and very well lighted they have been utilized to form an entrance lobby to each story, an antechamber, so to speak.

On the fourteenth floor are located the executive offices, and here the lobby and corridors are panelled in oak. The directors' room, which is the main feature of this floor, is a well proportioned room done in panelled oak. The offices on the street fronts of this story are given increased importance by opening out upon a balcony from which a fine view of the city and bay is obtained.

A description of the architecture of this building would be incomplete without some mention of the color scheme. In order to make the ornament, the fourteenth story arcade and other architectural detail appear to the best advantage the use of a light colored material was advisable. The most delicate ornament shows clearly, every line is revealed distinctly, and each shadow imparts its full impression on the light granite grey color chosen.

The red roof, which makes a bright spot of color at the top of the building, is in pleasing contrast to the grey walls. Similarly, the painted iron work of blue and gold at the entrance and the first story windows repeats a note of bright color at the base of the building. On the interior, a warm greyish tan forms the dominating color. This is found in the buff Bedford stone of the vestibule, on the walls of the offices and corridors, and is suggested in the greyish stain of the oak woodwork. A sparing use of brighter colors is also apparent, blue and gold for the letters on doors and entrances, on the fixtures and bulletin boards of the lobby, and in the stair balustrade.

The Financial Side of "Pacific Service"

Following is a summarized statement of the Company's income account for the six months ended June 30th, 1925, compared with the same period of the preceding year:

	1925	1924	Increase
Gross Revenue, Including Miscellaneous Income	$23,917,114.27	$22,200,484.45	$1,716,629.82
Maintenance, Operating Expenses, Rentals, Taxes (including Federal Taxes) and Reserves for Casualties and Uncollectible Accounts	14,199,405.65	13,738,605.97	460,799.68
Net Income	$ 9,717,708.62	$ 8,461,878.48	$1,255,830.14
Net Interest Charges	3,615,657.83	3,200,442.86	415,214.97
Balance	$ 6,102,050.79	$ 5,261,435.62	$ 840,615.17
Bond Discount and Expense	209,140.29	182,104.58	27,035.71
Balance	$ 5,892,910.50	$ 5,079,331.04	$ 813,579.46
Reserve for Depreciation	1,917,927.43	1,605,930.99	311,996.44
Balance to Surplus	$ 3,974,983.07	$ 3,473,400.05	$ 501,583.02
Preferred Stock Dividends (6%)	1,632,668.41	1,622,041.10	10,627.31
Balance	$ 2,342,314.66	$ 1,851,358.95	$ 490,955.71
Common Stock Dividends (8%)	1,739,430.39	1,424,596.00	314,834.39
Balance	$ 602,884.27	$ 426,762.95	$ 176,121.32

The Company's business continues to exhibit a healthy growth, as reflected in the increase of $1,716,630 in gross revenues and 14,321 in the number of customers served during the first half of the current year. Surplus available for Common Stock dividends was equivalent to $5.38 per share on the average amount of Common Stock outstanding during this period.

Pit Plant No. 3, one of the major hydro-electric power plants in the country, with an installed capacity of 108,579 horsepower and an annual output of approximately 400,000,000 kilowatt hours of electricity, was placed in operation during the latter part of July and will effect a considerable saving in operating costs during the remainder of the year through reducing substantially the quantity of fuel oil utilized in the Company's steam electric generating stations.

SALE OF FIRST AND REFUNDING MORTGAGE BONDS

In order to provide funds for a continuance of its construction program, the Company in May, 1925, sold to a syndicate headed by the National City Company a block of $10,000,000 par value of its First and Refunding Mortgage Series "D" 5 per cent Bonds on the most favorable terms upon which it has secured new capital since the outbreak of the war. The comparatively low yield basis upon which these bonds were sold was a result of the gradual lowering of interest rates which has characterized the general financial market in this country during the past few years, and the Company's excellent credit standing. The bonds met with a very ready reception among investors.

It is estimated that this Company's bonds are now held by in excess of 45,000 investors, in addition to approximately 21,000 holders of its Preferred and 15,000 holders of its Common stocks, making an aggregate of over 81,000 investors in the Company's securities.

FIRST PREFERRED STOCK A LEGAL INVESTMENT FOR SAVINGS BANKS IN NEW HAMPSHIRE

The Company was recently advised by the Board of Bank Commissioners of the State of New Hampshire that its First Preferred 6 per cent stock is a legal investment for savings banks in that state.

The direct sale by the Company to its stockholders and employees and to the local public of $12,500,000 par value of Common Stock during the past year has still further improved the exceptionally strong investment position of the Preferred Stock. The following table covering the past seven and one-half years indicates the growing margin of earnings over dividend requirements:

Year	Surplus Available for preferred Stock Dividends after Depreciation	Dividends Paid	Margin of Surplus over Dividends
1918	$3,071,303	$1,490,463	$1,580,840
1919	3,340,353	1,528,961	1,811,392
1920	3,922,061	1,777,933	2,144,128
1921	4,969,230	2,132,283	2,836,947
1922	6,587,159	2,574,157	4,013,002
1923	6,756,294	3,103,847	3,652,447
1924	7,028,349	3,244,609	3,783,740
*1925	7,529,932	3,262,745	4,267,187

*(12 months to June 30)

CONDENSED BALANCE SHEET, JUNE 30TH, 1925

Assets

Plants and Properties		$263,861,713
Investments		238,623
Discount and Expense on Capital Stock		8,983,237
Trustees of Sinking Funds (uninvested funds)		377,626
Current Assets—Cash	$13,013,308	
Other	13,083,653	26,096,961
Discount and Expense on Funded Debt in process of amortization, less Undistributed Suspense Items		8,133,148
Total Assets		$307,691,308

Liabilities

Common Stock Outstanding	$ 48,130,848
Preferred Stock Outstanding	54,464,532
Stock of Subsidiary Companies owned by public	18,003
Funded Debt in hands of public	162,385,800
Current Liabilities	9,436,179
Reserve for Renewals and Replacements	18,486,597
Other Reserves	4,402,481
Surplus Unappropriated	10,366,868
Total Liabilities	$307,691,308

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF
A. F. HOCKENBEAMER - BUSINESS MANAGER

Year's subscription - - - - - - $1.50
PACIFIC GAS AND ELECTRIC COMPANY
445 Sutter Street, San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVI JULY, 1925 No. 5

EDITORIAL

Now that the great convention of the National Electric Light Association has come and gone we who are concerned with progress and development in this Western land feel that we can look back upon that gathering of the clans in San Francisco with more than a passing thrill of satisfaction.

We are proud of the eminent position our State holds in the development of hydro-electric energy and its constantly increasing application; we were proud to hear those big men of the industry from the great centers of business activity on the far side of the Rockies acknowledge California's leadership in that respect.

There was a good deal said at the convention about inter-connection of electric distributing systems. It is generally known, of course, that such an interconnection has been established in California and travels the length of the State from the Oregon line to the Mexican border, but the general public may not yet have come to appreciate just what this accomplishment means, not merely to the electrical industry but, also, to the consumers of electric power, whether for agricultural, industrial or domestic purposes. Interconnection has suffered, perhaps, from the term "superpower" being imposed upon it. The term is not happy, for it is apt to arouse uneasiness, not to say suspicion, in the public mind. In this connection, then, it is worth while to call public attention to an address by Mr. Herbert Hoover, Secretary of Commerce in President Coolidge's cabinet, when, speaking before an audience of six thousand people in San Francisco's municipal auditorium, he said that the discovery of long-distance transmission and, from that, the erection of large central generation plants and interconnection of distribution systems had worked a positive revolution in the power industry, a revolution in the direction of adequate and dependable service, with economy of operation and resultant decrease of cost to the consumer. Furthermore, said Mr. Hoover, this central generation and interconnection did not and would not in any way alter the essential character of regulation by the State commissions having control of the public utilities in every department of their development and operation. A synopsis of Mr. Hoover's address appears elsewhere in this issue.

Another achievement to which California may point with pride is her record in customer ownership. California is universally admitted as the pioneer in this important step toward the only true public ownership that can possibly be of any benefit to the electrical industry. It was in 1914 that the Pacific Gas & Electric Company undertook to dispose of an issue of $12,500,000 preferred stock by direct sale to its stockholders, employees and consumers. The success of that undertaking at a time of decided financial uneasiness throughout the country is a matter of history. Since that time the practice is being adopted quite generally and statistics compiled by the Customer Ownership Committee of the National Electric Light Association show that 208 electric light and power companies in the country have adopted the customer ownership plan and in the ten years since its inception have obtained by it a total of 947,367 stockholders to whom a total of 7,525,572 shares have been sold. And, to California belongs the credit for having set in motion this plan that has done much to bring the public service and the public together in sympathy and understanding.

California has also developed the application of electricity on the farm to a greater extent than any other section of the country, if not of the entire world. From an investigation made at the close of 1924 the estimate was made that on the ranches of Cali-

fornia there were 35,500 electric motors in operation, these motors totalling approximately 483,965 horsepower. Eighty per-cent of them were used for driving irrigation pumps. There were in California at the time a total of 167,504 rural light and power consumers, that is, consumers outside of incorporated limits of cities, who were served by 16,513 miles of rural distribution line, which is an average of 10.1 consumers per mile. Other figures which show the high electrical development of rural territory tell us that in California there are 23 inhabitants per rural consumer and .95 square miles of territory per rural consumer.

No other section of the country can show figures anything like approaching these, and they are increasing daily.

Meanwhile, the hydro-electric construction program goes steadily on. It is a question of supply and demand and in the public service the supply may not fall short. In his opening address to the N. E. L. A. convention President Franklin T. Griffith, himself a Pacific Coast man, voiced the prediction that the light and power industry in the United States will need to raise money at the rate of $2,000 a minute for the next ten years. This money will be needed for power development. It is something stupendous to even contemplate, but in this twentieth century of big visions and big fulfillments we find ourselves thinking and speaking in terms of billions and with a tone of confidence that we would not have dared to assume a few short years ago.

Meanwhile, electricity's centenarian rival, gas, is more than holding its own as a commodity in popular demand. Though practically superseded by electricity as a lighting medium, it undoubtedly holds pride of place as a heating agent.

Business in gas-fired house-heating systems has advanced more than 2,000 per cent since 1919, states a statistical report recently issued by the American Gas Association. One of the largest manufacturers in the house-heating field made nearly 50,000 installations last year alone, and for that particular concern the record meant an increase of 6,000 per cent over 1919.

On the industrial side gas is now universally recognized as the best, most adaptable and most economical fuel. The ease with which its heat application can be controlled makes it of especial value in this respect. An instance of this which may interest our readers is found in coffee-roasting.

Roasting coffee is such a delicate operation that for many years every pound had to be prepared by hand and watched during every minute of the roasting process. Today in Brooklyn, N. Y., the world's largest green coffee center, eight gas-fired coffee roasters in one plant alone are turning out enough coffee every twenty minutes to supply a city of 5,000 families with coffee for a week. This same amount would supply an average family for ninety years, or through three generations. Using gas, this plant can roast sixty tons of coffee in an eight-hour day, and every bean will be as finely browned and flavored as in the old hand-roasting days.

The cost of roasting coffee with gas on this scale is only about ten cents per 135 pounds of coffee, or at the rate of about 1000 cubic feet of gas for 1670 pounds of coffee. Generally speaking, this is not far from six-tenths of a cubic foot of 565 B. t. u. gas per pound of coffee, or thirteen bags for every 1000 cu. ft. of gas used.

Another now popular use for gas is in the melting of metals employed in the manufacture of automobiles. Through absolute control of heat application thousands of spare parts are now turned out by automatic die-casting with a degree of accuracy unknown a few years ago, we are told. These dies must be alternately subjected to intense heats and cooling strains, consequently any large variation in the amount of heat would result in turning out an imperfect article.

The greatest development in the use of city gas for industrial purposes has, up to recently, been in cities of 40,000 population or over. The American Gas Association, however, reports that now in small cities the local gas companies are beginning to send out their products to industrial plants on a considerable scale, and this in spite of the fact that in small localities gas as a general rule costs considerably more than in cities of large population.



The "Pacific Service" pension roll. The above portraits are of eight former employees whose long and faithful service has earned them honorable retirement.

The "Pacific Service" Roll of Honor

Heading the honor roll of "Pacific Service" are 77 names of men whose long and faithful service to our company has been rewarded by their honorable retirement with provision for their declining years under our company's pension system, which underwent complete revision in the fall of 1921.

In preceding issues we presented the portraits of men whose names are upon our company's pension roll, accompanied by their several service records. In doing this we were actuated by a desire to make our readers acquainted with these men and their records and to point out what is generally recognized in all up-to-date business enterprise, namely, that long and faithful service shall have its reward.

Opposite this will be found another installment consisting of eight portraits of our company's pensioners arranged according to terms of service. These are:

R. C. Malone. 72 years of age, having been born in 1852. Entered the service of the San Francisco Gas Light Company in July, 1877, and at the time of retiring on a pension, May 1, 1924, was employed in San Francisco Division.

Allen H. Spurr. 63 years of age, having been born August 16, 1861. Entered the service of the Lakeport Saratoga Springs & Ukiah Telephone & Telegraph Company in 1891, and at the time of retiring on a pension, August 1, 1924, was agent for the California Telephone & Light Company at Lakeport, Calif.

Wm. G. Roundtree. 67 years of age, having been born March 31, 1857. Entered the service of the San Francisco Gas Light Company November 15, 1894, and at the time of retiring on a pension, December 31, 1924, was employed in San Francisco Division.

Jeremiah Murphy. 64 years of age, having been born in April, 1860. Entered the service of the San Francisco Gas & Electric Company in 1902, and at the time of retiring on a pension, October 1, 1924, was employed in San Francisco Division.

James H. Donald. 65 years of age, having been born March 12, 1859. Entered the service of the Sacramento Electric Gas & Railway Company March 29, 1902, and at the time of retiring on a pension, January 1, 1925, was employed in Sacramento Division.

John Clements, 80 years of age, having been born November 1, 1844. Entered the service of the Red Bluff Electric Light & Gas Company in November, 1905, and at the time of retiring on a pension, December 31, 1924, was employed in East Bay Division.

Wm. M. Vallette. 68 years of age, having been born November 1, 1856. Entered the service of the San Francisco Gas & Electric Company July 17, 1906, and at the time of retiring on a pension, September 1, 1924, was employed in San Francisco Division.

Michael McDonough. 70 years of age, having been born October 26, 1854. Entered the service of the Pacific Gas & Electric Company in August, 1908, and at the time of retiring on a pension, January 1, 1925, was employed in San Jose Division.

An Employees' Association 7000 Strong

An organization of employees that grows from a few hundred members to more than 7,000 in the short span of eight years challenges attention. Such is the remarkable record of Pacific Service Employees' Association, which was organized in the year 1917 and closed the year 1924 with 7,024 members. A resume of the activities of this Association will no doubt be of interest to our readers. Educational, social, recreational and beneficial activities form the ground-work upon which the organization has been builded.

EDUCATIONAL PLAN—The educational plan now in operation grew out of a series of meetings held when the Association was first organized for the purpose of discussing subjects appertaining to the utility operations of "Pacific Service." With the rapid growth of the membership the need for a comprehensive and practical educational program became apparent. Such a program the Association now has in effect founded upon the idea of helping the members to help themselves. This work is in charge of an Educational Committee, all of the members being employees of the Company and members of the Association. The Educational Committee decides the subjects upon which instruction is to be given, prepares the text of the courses and, after publication, distributes the same to the students who have enrolled for the different courses. The courses are designed to educate the employees along lines of the Company's activities in order that they may better understand the work they are doing and by study prepare themselves for better positions. Class room instruction, and assigned text book reading, is the prevailing method of instruction. Those who prepare the courses, as well as those who act as instructors, are selected because of their peculiar fitness for the task and expert knowledge of the subjects to which they give their attention. All are volunteer workers. When a student satisfactorily completes a course he is awarded a certificate as evidence of the fact. At the present time more than 1,000 students, in seventy and more classes, are receiving instruction in nine different subjects. Eight new and advance courses are being completed. In order that the students may better understand the subjects that are studied, on occasions they are taken to the Company's different plants and there may observe and have explained to them actual operations. Every effort is made that the educational work shall be of real benefit to the employees of the company. A complete record is kept of each student and when a course is successfully completed the student's card is forwarded to the manager of the Personnel Department in order that he may have a record of those employees who are endeavoring to fit themselves for better positions, and when the opportunity permits, recommend such employee for advancement. More than 600 students have successfully completed educational courses.

SOCIAL—The social activities of the Association are a very important factor in its success and include musical entertainments, athletics, dances and outings. At least one entertainment a month is held in each of the twelve geographical divisions of the Association, and from time to time special entertainments held under the auspices of the Association's Parent Body permit the gathering of several thousand members at one event. These are great family gatherings rather than public entertainments and are productive of a fine spirit of friendship, co-operation and good will.

During the past few years the Association has, with marked success, presented a number of comic operas, including "The Geisha Girl," "Prince of Pilsen," "The Mikado" and a number of one-act playlets, the talent for the plays being drawn from the membership.

The Association issues a monthly publication called the "News," which is distributed to those employees of the Company who are members of the Association. In it are published the doings of the Association and items concerning the employees. It may be likened to a college paper. By means of this publication the membership, whether located at the power houses in the mountains, in the valleys, or the larger cities, are kept fully important and interest in the Association maintained. The first issue of "News", consisting of six pages, was published in December, 1921. The issue of April, 1925, was thirty pages, which is an indication of its increasing popularity.

RECREATIONAL ACTIVITIES—The Association sponsors athletic activities, including base ball, tennis, swimming, bowling, basket ball, golf, etc., and competition between teams in the various divisions not only tends to develop good sportsmanship, but assists in keeping the participants physically fit. Three vacation camps located upon the Company's property in the Sierra Nevada mountains afford to the members and their families an opportunity to enjoy a vacation in California's great out-of-doors and at the same time to visit the Company's hydro-electric power plants in the course of construction and operation. The camps are being improved each year and are being used by an increasing number of the membership each summer and fall.

BENEFICIAL ACTIVITIES—The beneficial activities include a loan plan, death benefit plan and disability plan.

Under the loan plan a member may borrow from the Association up to $200.00. The interest rate is nominal and the money loaned is repaid in twelve equal monthly installments. Most of the loans granted are for the purpose of enabling members to pay bills incurred on account of sickness or death. Also, in some cases, to pay an accumulation of bills incurred for necessities of life. This assists the member not only to satisfy his creditors, but reduces to a minimum the borrowing of money by employees from one another and also relieves the member from embarrassment and worry.

The death benefit plan, as its name implies, is designed to make provision for the expenses of the last illness and funeral expenses of the members of the Association. The minimum benefit is $300.00 and the maximum, $500.00, dependent upon the number of years of membership in the Association. Inaugurated in 1920, the plan has proved to be of inestimable benefit to the members and their families. In 1924 the benefits paid under this plan amounted to more than $11,000.00.

Perhaps the most far-reaching and important work undertaken by the Association was the placing in effect in the latter part of 1923 of the disability plan. The objects of this plan is to provide for members, at a minimum expense, financial assistance when, by reason of sickness or accidental injury, they are unable to work at their usual vocations. The plan is strictly an employees' plan and is controlled and administered by the Executive Committee of the Association. It is financed entirely by the members of the plan, who contribute $1.00 per month per member. Benefits are paid at the rate of $20.00 per week, commencing with the eighth day of disability, and it is possible for a member to receive in one year maximum benefits in the amount of $600.00 for a total contribution during the same period of $12.00. The same staff that attends to the other activities of the Association administer this plan. Those who visit the sick and make the reports which form the basis of benefit payments are volunteer workers. This plan is founded upon the principle of mutual self-help. It provides a means whereby employees may, at a purely nominal cost, obtain a good measure of security against the distressing results that often follow in the wake of serious illness. The plan was inaugurated with 1,500 members and at the present time the membership exceeds 3,300. Benefits during the year 1924 totalled more than $21,000.00.

With such a sound and comprehensive program as has been outlined above it is no wonder that the Pacific Service Employees Association is now 7,000 strong!



Prominent officials of the recent National Electric Light Association Convention. In the center is Franklin T. Griffith, of Portland, Ore., President of the N. E. L. A.; at upper right, First Vice-president J. E. Davidson, of Nebraska, who now succeeds to the presidency; at upper left, Second Vice-president R. F. Pack, of Minnesota; at lower right, Wigginton E. Creed, San Francisco, Chairman General Convention Committee; at lower left, M. H. Aylesworth, New York

How the N. E. L. A. Came to San Francisco

High lights upon a convention that marked the fortieth anniversary of a great national industrial organization.

By FREDERICK S. MYRTLE

The National Electric Light Association held its annual convention in San Francisco this year, during the week of June 15th. Incidentally, it celebrated the fortieth anniversary of its useful existence. It is interesting to know that our Western metropolis was selected for the honor because of its position as the pivotal center of an industry that has made greater strides in this section of the country than anywhere else in the wide world.

"We are delighted to come to California for three important reasons apart from that of mere sight-seeing," said Mr. M. H. Aylesworth, managing director of the N. E. L. A. "First, the interconnection of distributing systems which stretches from Oregon to the Mexican line is unequalled elsewhere. Second, California was the pioneer in customer ownership. Third, California has progressed farther than any other state in the Union in the application of electricity to agriculture."

Mr. Aylesworth's tribute to our Golden State was heartily endorsed by all the great leaders of the electrical industry who made the trip to San Francisco from New York, Chicago and other great centers of activity east of the Rockies. Small wonder, then, that this convention will go down in history as one of the most successful from the standpoints of enthusiastic interest on the part of the delegates and appreciable value to the industry at large. To quote a leading electrical journal:

"The sessions were attended by greater numbers than have ever attended the sessions of former conventions. Scarcely ever have the optimists dominated N. E. L. A. gatherings to a greater extent and never has enthusiasm run so high."

There was a notable gathering of high executives and men distinguished in public life. Prominent among the latter were Secretaries Herbert Hoover and W. M. Jardine of President Coolidge's cabinet, who made the trip across the continent to address the convention upon two of the most important problems confronting the electrical industry today. The result was a really worthwhile four day's discussion, with the spacious Municipal Auditorium as the meeting place.

It would be an impossible task to attempt to detail the many interesting features of this convention in a limited space. It might be worth while, however, to touch upon some of the major points of general public interest.

Herbert Hoover spoke at the Public Policy Committee session, which is always made a special feature of convention week. It was held on the evening of Wednesday, June 17th and, the public being invited, drew an assemblage of over six thousand. Mr. Hoover chose for his subject "State versus Federal Regulation in the Transformation of the Power Industry to Central Generation and Interconnection of Systems." In this he upheld state regulation, opposing federal regulation as a wholly unnecessary invasion of local responsibilities.

The Secretary of Commerce reviewed the revolution now taking place in the power industry as a result of the discovery of long distance transmission and consequent economies from the erection of large central generation plants and interconnection of distribution systems. "I do not propose to refer to this as either 'superpower' or 'giant power'," he said. "Both these terms are blamed with connoting something that is not existent in power production. 'Super' power has been envisaged as some overwhelming sinister en-

croachment into public rights. 'Giant' power has been interpreted by extremists to be like any giant hitherto known, having its only realism as a bogey, as entertainment for children, or as a side show for the political circus. However, the practical everyday fact is that all this development is simply a centralization of power houses and interconnection of distributing systems. We had better stick to our engineering terms to describe what the thing really is—Central Generation and Interconnection of Distribution Systems. If anybody can find evil or humor or poetry in these terms, he will need to be ingenious."

Mr. Hoover assured his hearers that central generation and interconnection do not in any way alter the essential character of regulation. "During the past year," he said, "The Department of Commerce has been engaged upon a study of the effectiveness and the results of state regulation of the industry. It is scarcely necessary for me to say that there is either state or municipal regulation of the rates of electrical utilities in all but two of the states, and of service in all but five of the states. The financial operations of such utilities are supervised and controlled in a large majority of states. These principles are being rapidly extended over the few remaining states.



United States Secretary of Commerce Herbert Hoover, who delivered an important address on "Regulation"

"No one can survey the work of the state commissions and the instructive series of court decisions concerning their ruling as a whole without realizing that we are gradually developing a science of regulation and of understanding, on one hand, of the means of drawing the fine line between minimum rates to the people and, on the other hand, of such a reasonable profit to the industry as will stimulate its advancement.

"It is my belief from this investigation that the public service commissions with very little just criticism are proving themselves fully adequate to control the situation. The laws as written in the state statute books are sufficient to protect both the public and the industry, the two parties to the utility contract.

"As to the reasonableness of rates, it may be observed that the nationwide average shows that rates are today slightly below pre-war and this despite an increase of 100 per cent in wages, together with increased cost of fuel and of many supplies. While the price per kilowatt has shown a small decline since before the war, yet beyond this the technical improvement in lamps has resulted in a four-fold increase in the amount of light dispensed for the same money. Of perhaps broader significance in this test is the fact that the total interest and dividends paid by the industry in 1912 amounted to under 4 per cent on the estimated valuation of the industry; in 1917 it was under 5 per cent and in 1922 it was under 6 per cent and again about 6 per cent in 1924. It might be observed that the rate of taxation of private plants increased about 400 per cent, that is, from about 0.6 per cent on the estimated valuation of 1912 to 2 per cent in 1924.

"It does seem to me these facts demonstrate that in the nationwide sense our state legislatures have been equal to their task of protecting the public and that the state commissions are doing their jobs well.

Likewise, democracy is demonstrating its ability to retain mastership in its own house."

Under the heading of probable future expansion, Mr. Hoover discussed the electrification of transportation which, he said, must inevitably call forth great increases in the demand for available power. He thought that by 1930 the central stations of the country would probably need an additional capacity of fully 30 per cent, carrying them up to nearly 36,000,000 horsepower and involving some five billion dollars of additional investment. He realized that this enormous expansion might awaken some anxiety in the public mind concerning the adequate protection of the public interest. However, he thought the matter was one mainly concerning the public education. The public must be brought to understand that the technology of central generation and interconnection requires that the business must grow in the size of capital necessary for great power houses and district systems if the people are to enjoy the benefits of low-priced power.

"You cannot buy a 100 horsepower generator at a 10-cent store," said Mr. Hoover with marked emphasis.

It was an able, well-ordered address, delivered in the Secretary's quiet but incisive manner, and was listened to with marked attention. At its conclusion Mr. Hoover was warmly applauded.

On this occasion the report of the Public Policy Committee was presented by Mr. Martin J. Insull of Chicago. In this Mr. Insull called public attention to the fact that while since the war the cost of commodities generally had risen 65 per cent the electrical industry had succeeded in actually reducing its cost to the public by 8½ per cent.

Mr. Insull estimated the present output of electrical energy in the United States at 60,000,000,000 kilowatt hours a year, representing in energy the work of 8,000,000 horses.

Views similar to those expressed by Mr. Hoover upon this question of state versus federal regulation were voiced at another session by Hon. W. D. B. Ainey, of Pennsylvania, President of the National Association of Railway and Utilities Commissioners. Judge Ainey took the position that local conditions should be dealt with by local authorities.



Judge W. D. B. Ainey, president National Association of Railway and Utilities Commissioners, who spoke against Federal regulation.

"There is a wide divergence between the electrical problems of California and those presented in the East, between those of the South and Southwest," said Judge Ainey. "It seems obvious that for the public welfare a state commission composed entirely of men familiar with local conditions is better qualified to speak concerning them than a Washington commission drawn from the country at large. No centralized federal agency can have that locally intimate touch which is essential for the public to have in order that correctional matters may be speedily and promptly adjusted."

Hon. William M. Jardine took in San Francisco during an inspection tour of the country in which his purpose was to obtain first-hand information concerning the problems of production, transportation and marketing as they apply to farmers of the Middle West, the intermountain regions and the Pacific Coast. The United States Secretary of Agriculture is himself a prac-

tical farmer and he is delving deeply into all matters that concern the farming industry, so that it was with great interest that the convention heard him deliver an address at a general session at which rural electric service and the relation of electricity to agriculture were prominent topics of discussion.

The report of the Committee on the Relation of Electricity to Agriculture was presented by Dr. E. A. White, of Chicago, as Director. It was the second annual report since the organization of the national committee, since which time the work has been enlarged by the organization of state committees for the specific purpose of making a comprehensive study of the rural electric service problem in its local application. Concerning immediate prospects. Dr. White said:

"A comparison of agricultural statistics with the electrical transmission map published about one year ago by *The Electrical World* leads to the concluion that today at least 25 per cent of our 6,484,383 farms are within reach of power lines. For round numbers, take 1,500,000 farms. It may be worth the effort to attempt to secure a picture of just what this undertaking means. Taking what has come to be accepted as a reasonable average, one mile of distribution line for three farms, at the conservative figures of $1000 per mile gives an investment of $500,000,000 to reach less than one-fourth of our farms. Data now available leave no doubt that to use electric service properly the individual farmer should spend for wiring and equipment at least two dollars for every dollar which goes into distribution lines. Here is $1,000,000,000. Adding these two sums, we find that to make rural electric service at all effective on less than 25 per cent of our farms is a financial undertaking of $1,500,000,000, or four times the money spent by the United States in building the Panama Canal. Certainly an undertaking of such magnitude calls for ability of no mean order. Each group, agriculture, light and power industry, equipment manufacturers, will be justified in taking more than a casual glance before it leaps. If progress is to be made secure capital will not only have to be raised but, also, strict attention given as to how returns are to be earned.



United States Secretary of Agriculture Wm. M. Jardine, who favored the electrification of the agricultural industry

"In this connection it is most gratifying to be able to report that the electric light and power industry has not only contributed financial support for developing a plan to guide this undertaking, but has made available the services of some of the best men in your ranks. There is every reason to be proud of the constructive record which these men have made for your industry."

Dr. White's report was followed by an interesting address by Mr. L. J. Taber, of Columbus, Ohio, Master of the National Grange, who chose for his topic "Electric Sunshine for Agriculture." "Electric sunshine, or rather, the power, light, and heat that electric energy so easily furnishes, means more to agriculture than to almost any other industry," said Mr. Taber. "The drudgery of household cares is peculiarly heavy in the farm home and yet there is no house task but that electricity can lighten or brighten.

"About half a million of our farmers have electric equipment and an equal amount have running water in the home. There are two million farm homes in America awaiting electric installations

when prosperity returns to them and when the electric industry awakens to its possibilities."

Mr. Jardine, who followed, warmly complimented the electric industry upon the initiative it had shown in promoting the organization of a national committee headed by Dr. White. "Seldom," he said, "has there been such a constructive attempt as this to get the co-operation of all parties concerned to aid in the solution of a great problem."

He regarded the application of power to agriculture as of importance both to the agricultural industry and to the public in general. In this era the progress of a nation, both economically and socially, could be measured to a considerable extent by the amount of power used per capita. In California, where rates for power were more favorable than in other sections of the country and where the type of agriculture lent itself more readily to the utilization of electricity, fully 50 per cent of the farms were electrically served; but this was not the case in other sections of the country where the relatively high cost of transmission line construction, combined with the low load factor obtained, the mobile nature of many of the farm operations and the lack of fundamental information on which to base the charges for the current consumed had prevented the wide application of this type of power to farm operations. To quote Mr. Jardine:

"The most serious difficulty connected with the distribution of electrical energy to rural communities seems to be to get the average customer to use sufficient current to give the central station a reasonable return on its investment without making an unreasonably high charge per unit of energy consumed. In most cases, when a rural line has been constructed the farmers have availed themselves of it for supplying lights to their houses and barns and, perhaps, for the operation of a few small machines requiring little current; but they have not extended its use farther. Obviously, the central service stations cannot be expected to invest money in rural service extension unless they receive a reasonable return on their investment. On the other hand, it must be recognized that agriculture cannot utilize electrical energy extensively unless its cost and the returns from its use are such as to make the practice profitable. The farmer has a keen understanding of relative power costs as they apply to his conditions and he employs only those practices that yield the larger profit."



E. A. White, Chicago, director of the National Committee on the Relation of Electricity to Agriculture

Mr. Jardine urged the electric service companies to make a thorough study of the transmission problem as applied to rural service and to adopt the most economical type or types of construction consistent with good service and proper safeguards to the public. They should, he thought, make a thorough study of their rates and so adjust them as to encourage more extensive use of electricity for power. In conclusion, Mr. Jardine said:

"Electricity has already made important contributions both to labor saving on the farm and to a more modern, satisfying rural life. I am confident that it is going to make further contributions of equal and greater importance. The farm offers the greatest potential opportunities open to the electric industry. Electricity, in turn, offers to agriculture vast potentialities for the development of more efficient farming

and a more permanent agriculture and rural system. Agriculture and the electric industry can eventually convert these possibilities into realities by coming to a mutual understanding of difficulties and by cooperating in sound investigation and in careful application of results."

Many other features of both general and departmental sessions are worth recording. President Griffith's address on the opening day was a capable review of the electrical industry during the forty year's existence of the N. E. L. A. It was interesting to learn that forty years ago the association started with a charter membership of sixty-five and that there are now fifteen thousand members on the roll. Forty years ago the entire output of the central stations was about 175,000,000 kilowatt hours; now hundreds of companies each produce more than that volume of energy. Forty years ago the total capitalization of the electrical industry was slighty over fifty million dollars; today the aggregate financial structure reaches a total of over seven billions. Meanwhile, the rate of progress is increasing almost hourly, and President Griffith voiced the prediction that the light and power industry of the United States will need to raise money at the rate of two thousand dollars a minute for the next ten years!



L. J. Taber, Ohio, Master of the National Grange

President Griffith discussed customer ownership, relating that during the past year the public had bought or subscribed for junior securities of light and power corporations to the extent of nearly four hundred million dollars, the number of investors in these securities today being estimated at nearly three millions. It was necessary, he thought, to keep up a never-ending campaign to properly establish the electrical industry in the public favor. "Our business must rest its cause mainly upon public opinion," said Mr. Griffith. "Our work is never done and never will be done. We must keep everlastingly on the job. We must be clean and fair in all our dealings with the public as we may not expect to have confidence reposed in us if we are not worthy of it. We should develop to its limit the plan of true public ownership as exemplified in customer ownership. We should make public service an open book in which both friends and enemies can find facts and nothing but facts."

Along similar lines was the report of the Water Power Committee, presented by Mr. W. E. Creed as Chairman. The report urged the education of the public to a realization that the power companies have installed their plants and built their lines in the public interest. The public should know that each step of the way is safe-guarded, that no federal right or property is parted with, that state water is not taken unless it can be shown that by its taking the public can be benefited.

The report showed that power developments authorized by the Federal Power Commission but not yet begun would require at least one billion dollars to complete and two billion dollars more for transmission lines and distribution systems. Applications now pending would require ten billions for the developments of some 2,000,000 horsepower and the construction of transmission lines and distribution systems, and it was obvious that only a portion of this power could be utilized in the time limit set by law. It would be in the public interest, thought the committee, to clothe the Federal Power Commission with some latitude of discrimination in the is-

suance of permits and licenses, authorizing only the development of utilities supplying service and in a position to utilize the power applied for, or isolated industries, which could show that the power to be developed would be put to a beneficial use. In conclusion the report said:

"It perhaps cannot be too often repeated that in the development of water power the course of the industry has been steadily upward. Great scientific advances have been made and innumerable physical obstacles overcome. Always the goal has been towards cheaper and better service. All that has been accomplished has been done through private courage and initiative."

Most interesting were the sessions of the Public Relations Section presided over by Mr. M. S. Sloan, of Brooklyn, N. Y. The all-important problem of public relations was discussed from every possible angle. A popular note was struck in the report of the Committee on Customer Ownership, presented by Mr. A. Emery Wishon, of Fresno, as Chairman. Mr. Wishon has made customer ownership a study for many years and in his addresses has always approached it from the standpoint of self-interest, holding that it is to the decided advantage not only of the utility but of every member of the community served by it to establish the only true public ownership, namely, ownership by the public as share holders in the utility enterprise.

The committee report showed excellent progress made by customer ownership through the country. A feature of special interest was the presentation of ten cardinal rules for the prosecution of all stock-selling campaigns. Those in the main are directed to the establishment of relations of confidence between the utility and the public through personal contact and the display of the utmost candor on the part of the utility with respect to its operations and general condition.

At the same session of the Public Relations Section was held a symposium under the heading: "The Investor's Viewpoint." Mr. Haley Fiske, President of the Metropolitan Life Insurance Company, New York, told of the growing regard in which insurance companies held the securities of light and power concerns. Mr. Henry M. Robinson, President of the First National Bank, of Los Angeles, discussed the subject from the point of view of the commercial bank, telling of the part played by these institutions in raising the vast sums necessary, from time to time, to the progress of the electrical industry. Mr. B. C. Forbes, financial writer for the Hearst publications and editor of *Forbes Magazine,* New York, made an address from the point of view of the customer owner. In this he presented significant figures showing the growing confidence of the public in the utilities business, at the same time reminding those before him that this very public confidence laid grave responsibilities upon the shoulders of the utilities' operators, responsibilities, however, which he felt would be met. The investment house was represented in an address by Mr. Francis E. Frothingham, of Boston, Mass., who in an exposition of the best accepted methods of financing declared his opinion that, when carefully administered, the utility business offered a quality of investment second only to government securities.



A. Emery Wilson, Fresno, chairman Customer Ownership Committee

Mr. S. Z. Mitchell, President of the

Electric Bond and Share Company, New York, spoke for good service to the customer combined with economical management and operation. He greatly favored the establishment of holding companies, by the grouping of smaller operating concerns under one head, for the standpoints of both economy and security.

A session of the Public Relations Section was given over to the women, Miss R. E. McKee, of Chicago, Chairman of the Women's Committee, presiding, and many addresses were made upon the part played by women in public utilities organizations.

"What Electricity is Doing for Women" was the subject of an address before the convention in general session by Mrs. John D. Sherman, of Washington, D. C., President of the General Federation of Women's Clubs. Mrs. Sherman regarded homemaking in the United States as the greatest industry in the nation, and she suggested cooperation between the organization she represented and the N. E. L. A. in a campaign to raise the standards of the American home.

The foregoing may be regarded as the high spots, from the standpoint of general public interest, of this remarkable convention. The sessions of the Technical, Commercial, and Accounting Sections were well attended in all instances, and much of value to the practical side of the industry was evolved from their deliberations.



Frank A. Leach, Jr.. San Francisco, chairman of the Executive Committee of the Convention which directed all local arrangements

All arrangements for the convention, with the sole exception of the program of business sessions, were directed by an executive committee composed of members of the Pacific Coast Electric Association, a geographical division of the N. E. L. A., under Mr. Frank A. Leach, Jr., of the P. G. & E., as Chairman. Mr. Leach and his various committees worked hard to prove to our visitors from the East the truth of the saying that "San Francisco knows how."

Overshadowed as it was by the major assemblage, the annual convention of the P. C. E. A., which in ordinary years is spread over the better part of a week, was restricted to one brief session. The customary reports and papers were presented and filed and found their way into print by the courtesy of *The Journal of Electricity*. Mr. Leach, as president of the local association, called the convention to order, and after the various departmental reports had been received called for that of the nominating committee. The following will rule the destinies of th P. C. E. A. for the ensuing twelvemonth:

President, William Baurhyte, Los Angeles Gas and Electric Corporation.

First Vice-President, S. Waldo Coleman, Coast Counties Gas & Electric Company.

Second Vice-President, W. L. Frost, Southern California Edison Company.

Treasurer, J. F. Pollard, Coast Valleys Gas & Electric Company.

Executive Committee: F. A. Leach, Jr., Pacific Gas and Electric Company; F. E. Boyd, General Electric Company; F. H. Woodward, Great Western Power Company; A. E. Holloway, San Diego Consolidated Gas & Electric Company; F. O. Dolson, Southern Sierras Power Company; A. M. Frost, San Joaquin Light & Power Corporation; D. E. Harris, Pacific States Electric Company; J. C. Rendler, J. C. Randler, Inc.; C. T. Hutchinson, *Journal of Electricity;* C. E. Heise, Westinghouse Electric & Manufacturing Company; P. M. Downing, Pacific Gas & Electric Company; A. B. Day, Los Angeles Gas and Electric Corporation.

PACIFIC GAS & ELECTRIC COMPANY

A California Corporation

Managed by Californians Operated by Californians

"Pacific Service" Represents (as of December 31, 1924)

9,936	employed in all departments.
$249,000,000	capital invested in gas, electricity, railroads, steam, water and telephone plants.
59,000	square miles of territory in which it operates—an area greater than that of England and Wales.
31,859	stockholders.
38	counties of the State in which it transacts business.
763,617	consumers served with gas, electricity, water and steam.
2,158,000	people served in 38 counties, which is over 50 per cent of the State population.
291	cities and towns in which it supplies service directly and through other companies.
$19,198,269	annual wages paid employes in 1924.
$2,995,561	taxes, state and county, for 1924.
$927,117	taxes, Federal Government for 1924.
426,239	horsepower developed in 27 electric water-power plants.
190,349	horsepower developed in 4 electric steam plants.
616,588	total horsepower developed in 31 plants.
1,333,854,367	kw. hrs. sold. This is equivalent to the effort of 4,446,000 men.
15,277,477,500	cubic feet of gas sold in 1924.
17	gas plants.
12,186	miles of transmission and distribution lines. Greater than the distance between San Francisco and Calabar, West Africa.
3,833	miles of mains used in distributing gas. Greater than the distance between San Francisco and Santiago, Cuba.
1,100	miles of mains and ditches used in distributing water.
1,100	miles of track of street railway supplied with electric power.
70,340,568,100	gallons of water storage capacity in 109 lakes and reservoirs. This amount of water would supply the City of San Francisco at the present rate of consumption for nearly 5 years.
115,501	acres of land owned in California.
258	parcels of property owned in cities and towns.
6,672,014	barrels of California Oil used, year ending July 31, 1924.
178,744	horsepower in agricultural motors depending on "Pacific Service."
600,745	horsepower in mining, electric railways, manufacturing and other motors depending on "Pacific Service."
38,351	street lamps, gas and electric, lighted by "Pacific Service."
7,029,214	incandescent lamps nightly lighted.
1,367,501	horsepower connected to system.

Pacific Gas and Electric Company

General Office: 245 Market Street

San Francisco

Branches in all principal cities and towns of 38 counties of North Central California.



Back of

PACIFIC GAS AND ELECTRIC COMPANY SECURITIES

are the resources of

NORTHERN CALIFORNIA

The Pacific Gas and Electric Company furnishes services of a nature essential to the agricultural, industrial and commercial development of the vast territory in which it operates.

In this rich and progressive field the Company serves a population of 2,200,000. Over 775,000 customers are connected to its lines. *Its bonds and stocks are held by* 80,000 *investors, every one of whom is receiving interest or dividends regularly.*

The Company's Three Major Security Issues are:

First and Refunding Mortgage Bonds

First Preferred Stock (6%)

Common Stock (8%)

PACIFIC GAS AND ELECTRIC COMPANY

PACIFIC COURTEOUS CONTINUOUS SERVICE

PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO



HIGHWAY BRIDGE OVER DIVERSION DAM, PIT THREE DEVELOPMENT

Vol 16 — OCTOBER 1925 — No 6

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER	A. B. C. DOHRMANN	FRANK A. LEACH, JR.
F. B. ANDERSON	JOHN S. DRUM	NORMAN B. LIVERMORE
CHAS. L. BARRETT	F. T. ELSEY	JOHN D. McKEE
W. E. CREED	D. H. FOOTE	JOHN A. McCANDLESS
W. H. CROCKER	A. F. HOCKENBEAMER	C. O. G. MILLER

OFFICERS

W. E. CREED . . . . . *President*
FRANK A. LEACH, JR. . . . . *First Vice-President and General Manager*
A. F. HOCKENBEAMER . . . . . *Second Vice-President and Treasurer*
D. H. FOOTE . . . . . *Third Vice-President and Secretary*
CHAS. L. BARRETT . . . . . *Assistant Secretary*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, JR., Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney . . . . . LAW DEPARTMENT
C. P. CUTTEN, Attorney . . . . . RATE DEPARTMENT
R. J. CANTRELL, Manager . . . . . PROPERTY AND TAX DEPARTMENT
E. W. HODGES, General Auditor . . . ACCOUNTING DEPARTMENT
H. T. TERRY . . . . . CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager . . . . . CREDIT AND STOCK SALES DEPARTMENTS
JOHN H. HUNT, Purchasing Agent . . PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent . . . SUPPLY DEPARTMENT
E. G. McCANN, Manager . . . . PERSONNEL DEPARTMENT

ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT

O. W. PETERSON . . . . . Engineer of General Construction
E. H. STEELE . . . . . Engineer of Line Construction
F. R. GEORGE . . . . . Engineer of Operation
GEO. H. BRAGG . . . . . Engineer of Maintenance

DEPARTMENT OF ENGINEERING

J. P. JOLLYMAN . . . . . Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER . . . . . Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE . . . . . Chief of Division of Civil Engineering
F. M. HARRIS . . . . . Chief of Bureau of Specifications and Estimates
O. A. KNOPP . . . . . Chief of Bureau of Tests and Inspection

DEPARTMENT OF EXECUTIVE ENGINEER

F. C. PIATT . . . . . Valuation Engineer of Electric Properties
J. T. RYAN . . . . . Valuation Engineer of Gas, Water and Railway Properties
B. B. BECKETT . . . . . Rate Engineer
S. B. SHAW . . . . . Automotive Engineer
W. G. JACK . . . . . Manager Land Department

GAS CONSTRUCTION AND OPERATION DEPARTMENT

FRANK WILLS . . . . . Engineer of Production
R. S. FULLER . . . . . Engineer of Distribution
HARRY J. SMITH . . . . . Engineer of Construction

PUBLIC RELATIONS AND SALES DEPARTMENT

R. W. ROBINSON . . . . . Assistant to Vice-President in Charge of Public Relations and Sales
DON C. RAY . . . . . Manager Bureau of Public Relations
N. R. SUTHERLAND . . . . . Manager Commercial Department
H. M. CRAWFORD . . . . . Sales Manager
R. T. STEPHENS . . . . . Manager Electric Sales
FORREST U. NAYLOR . . . . . Manager Gas Sales
J. CHARLES JORDAN . . . . . Manager Publicity Department

W. B. BOSLEY
General Counsel

JOHN P. COGHLAN
Assistant to the President

F. S. MYRTLE
Editor-in-Chief Pacific Service Magazine

DIVISIONS AND MANAGERS

DIVISION MANAGERS		DISTRICT MANAGERS		HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION			Marysville
		J. V. KYLE	Colusa District	Colusa
I. B. ADAMS	DE SABLA DIVISION			Chico
H. M. COOPER	DRUM DIVISION			Auburn
		L. H. HARTSOCK	Nevada District	Nevada City
I. H. NEWBERT	EAST BAY DIVISION			Oakland
		J. H. PAPE	Berkeley District	Berkeley
H. C. ROSS	FRESNO DIVISION			Fresno
H. G. RIDGWAY	NORTH BAY DIVISION			San Rafael
		L. J. PETERSON	Petaluma District	Petaluma
		C. D. CLARK	Napa District	Napa
		C. D. CLARK	Vallejo District	Vallejo
		M. G. HALL	Santa Rosa District	Santa Rosa
E. W. FLORENCE	SACRAMENTO DIVISION			Sacramento
		C. W. McKILLIP	Sacramento District	Sacramento
		C. E. SEDGWICK	Solano District	Dixon
		J. W. COONS	Yolo District	Woodland
HENRY BOSTWICK	SAN FRANCISCO DIVISION			San Francisco
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION			Modesto
		W. E. ESKEW	Electra District	Jackson
		C. R. GILL	Modesto District	Modesto
		J. H. FAGG	Stockton District	Stockton
		CHAS. H. NOACK	Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION			San Jose
		W. T. KELLOGG	Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION			Redding
		M. P. WERRY	Pit River District	Fall River Mills
H. B. HERYFORD	WEST SIDE DIVISION			Red Bluff
		STEPHEN GOIN	Willows District	Willows
		CHAS. HUGHES	Red Bluff District	Red Bluff

Pacific Service Magazine

Volume XVI Number 6

Contents for October, 1925



"PACIFIC SERVICE" AS AN AID TO AGRICULTURE - *Frontispiece*

THE MOTOR AND THE FARM—
CALIFORNIA AGRICULTURE OFFERS AN UNPARALLELED EXAMPLE OF THE EFFICIENCY OF ELECTRIC POWER - *L. J. Fletcher* 171

HOW "PACIFIC SERVICE" BLAZED THE TRAIL—
RURAL ELECTRIFICATION HAD ITS BEGINNING IN THE SOLUTION OF THE HYDRO-ELECTRIC TRANSMISSION PROBLEM - - - - - - - *F. S. Myrtle* 174

IN THE SACRAMENTO RIVER COUNTRY—YOLO DISTRICT - 177

IRRIGATION ON THE WEST SIDE—
GLENN-COLUSA DISTRICT - - - - - - - - 180

IN THE FOOTSTEPS OF THE PADRES—
THE VALLEY OF SANTA CLARA - - - - - - - 182

AS IF BY MAGIC—TRANSFORMING THE
VALLEY OF THE SAN JOAQUIN - - - - - - 184

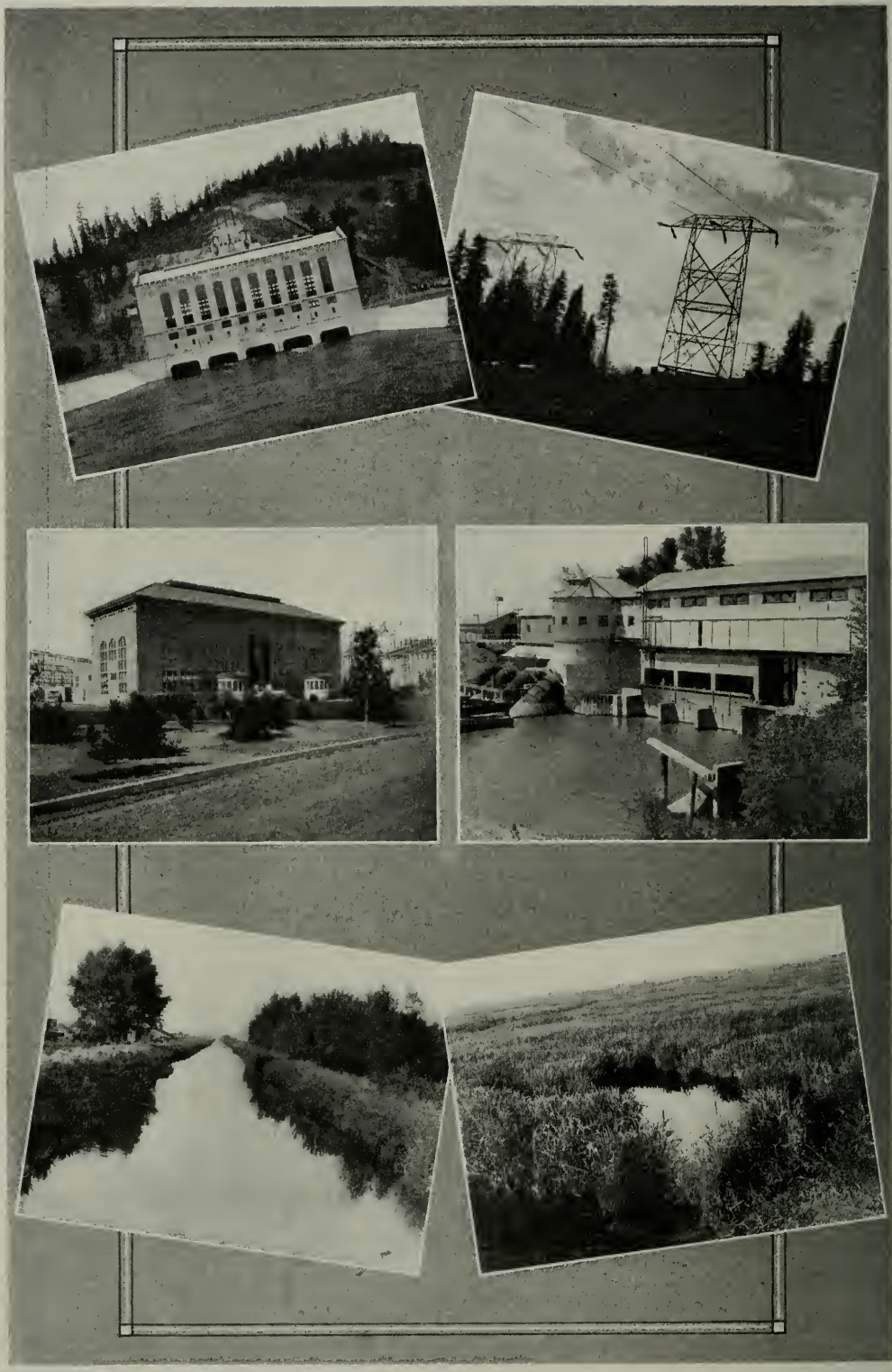
WHERE FOREIGN PLANTS ARE NURTURED—
THE U. S. GARDENS NEAR CHICO - - - - - - 190

ELECTRICITY IN THE CHICKEN COUNTRY - - - - 193

IRRIGATION BY OVERHEAD SPRINKLING - *H. A. Wadsworth* 194

THE FINANCIAL SIDE OF "PACIFIC SERVICE" - - *A. F. H.* 196

EDITORIAL - - - - - - - - - - - - - - 198



"Pacific Service" as an aid to agriculture. The progress of electricity from the source to the farm. Reading from the top, left to right, these views show: power-house; transmission line; distributing sub-station; valley pumping plant; irrigation canal; rice field.

PACIFIC SERVICE MAGAZINE
Volume XVI OCTOBER, 1925 Number 6

The Motor and The Farm

California Agriculture Offers An Unparalleled Example of the Efficiency of Electric Power

By L. J. FLETCHER
Head of the Agricultural Engineering Department, College of Agriculture, University of California.

No doubt the newspaper editor was sincere who, only sixty-one years ago, wrote the following:

"A Fraudulent Hoax

"A man about 46 years of age, giving the name of Joshua Coppersmith, has been arrested in New York for attempting to extort funds from ignorant and superstitious people by exhibiting a device which he says will convey the human voice any distance over metallic wires so that it will be heard by a listener at the other end. He calls the instrument a 'telephone,' which is obviously intended to imitate the word 'telegraph' and win the confidence of those who know of the success of the latter instrument without understanding the principles upon which it is based. Well-informed people know that it is impossible to transmit the human voice over wires as may be done with the dots and dashes and signals of the Morse Code, and that, were it possible to do so, the thing would be of no practical benefit.

"The authorities who apprehended this criminal are to be congratulated, and it is to be hoped that his punishment will be prompt and fitting that it may serve as an example to a horde of other conscienceless schemers who enrich themselves at the expense of their fellow creatures."

What terrible punishment would this wise editor have recommended for poor old Joshua Coppersmith had he been peddling radio sets. The infallible judge, Time, the friend of the affirmative in all debates between progress and stagnation, has decided in favor of the telephone.

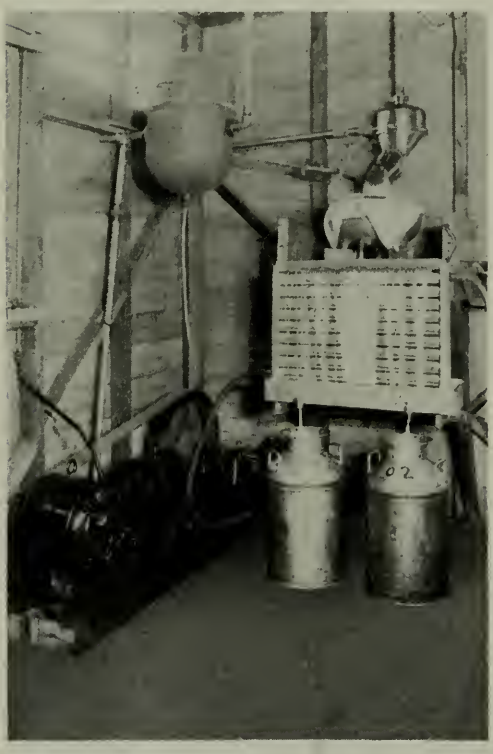
The means for progress were seldom requested and often condemned by those who eventually benefitted. Farm hands destroyed the early implements built to make their labors less arduous and more efficient; the rails and roadbeds of the first railroads were destroyed by farmers and stagecoach drivers; American cities legislated against the automobile. But the annual yield of our "It can't be dones" continues undiminished—failures of this crop are unknown.

Electricity, the willing servant which, with its four hands, furnishes us with heat, light, power and chemical energy, has revolutionized our manufacturing and transportation. Agriculture is now seeking to make wider and more efficient use of electricity. Just as the most significant feature of the progress of American agriculture during the past century has been the introduction of machine methods of production, the present generation is faced with the problem of making more efficient use of this farm machinery. Lowering production costs is a vital problem facing every farmer in the United States today. The following significant statement appears in a recent government bulletin:

*"Since power and labor represent on the average approximately 60 per cent of the total cost of producing farm products, a better understanding of the power requirements of farm operations will undoubtedly show the great opportunities that exist for material reductions in production costs through the adoption of more efficient and less expensive types of power units and by a more extensive use of power to replace expensive human labor."

*From U. S. D. A., Department Bulletin No. 1348—"An Appraisal of Power Used on Farms in the United States," by C. D. Kinsman, July, 1925.

California agriculture offers an outstanding and unparalleled example of the use of power, more especially electric. But 18 per cent of the power used on the farms in the Golden State is furnished by work animals, and of the remainder electric motors deliver 42 per cent. An increased efficiency in production has resulted, largely due to the extensive use of mechanical and electrical energy. The average load factor, that is the percentage that the useful work obtained is of full load continuous operation, is less than 4 per cent for all farm power in the United States; it is over 6 per cent for all farm power in California, and over 13 per cent for the electric power used on farms in this state. The average cost per horsepower hour for all farm power in the United States is 19 cents; in California, due largely to the low cost of electric power, this average cost is 9 cents.



Electricity plays an important part on dairy farms today. It operates the milking machine, circulates cold water or brine through the coolers, and there is now being developed an electric sterilizer for dairy utensils.

In some dairies portable motors are used to operate ensilage cutters and hay choppers.

The average crop value per acre of improved land in the United States is $29; in California, $53.

A measure of progress in agriculture is the amount of power controlled per farm worker. The California farm operator utilizes over four times as much power on his farm as the average farmer in this country, and his net income is larger than that of the farmer in any other state and over twice the average for the United States.

It is difficult to visualize the 554,000,000 horse power hours per year, the amount of electric energy used in California agriculture. This is more energy than that annually required for operating all of the seeding and planting machinery on the farms in the United States. It is more than five-eighths of the power used to harvest all the crops in this country. An interesting comparison may be to assume that all the automobile owners in California decided to give a grand joy ride to the entire population of the state, driving from the Imperial Valley to the Oregon line; they would use much less power on the trip than that furnished to our farms by the electric power companies each year. If all the wells in California now equipped with electrically operated irrigation pumps were furnished with hand pumps instead, and all the men, and boys over fifteen years of age, in the state were set to work pumping ten hours each day, every day in the year, they would be able to deliver, altogether, less than one-third the water now furnished by electrically operated pumps during the irrigation season.

About 80 per cent of the electricity furnished our farms is used to operate irrigation pumps. This furnishes the major, or base, load and makes possible the extending of the power lines in the rural districts. But today we also find electricity furnishing heat for the incubation and brooding of chicks, dehydration of walnuts, sterilization of dairy utensils, and the operation of ranges and water heaters in farm homes; it furnishes power for motors in farm shops, ensilage and hay cutters, dehydrator, ventilating fans, milking machines and refrigeration machines on dairy farms, wood saws, feed choppers and grinders, and domestic water supply systems; it furnishes light for the farmstead and by

means of clock-controlled switches automatically lights the poultry house so the hens will have a longer time to eat and thus produce more eggs during the winter season. This remarkable form of energy is also used to shock flies to death on electric fly killers and charge storage batteries for the car and radio set.

Electricity transforms the farm home. It may very largely be credited with the fact that over 60 per cent of the farm homes in California have water under pressure piped into the house, while the average for the farms in the United States is but 10 per cent. About the same ratio holds for the electric lighting of farm homes. It makes possible the appliance, next to running water, most desired by farm women—the electric iron, as well as the small motors in the home operating the washing machine, automatic refrigerator, fan, sewing machine and vacuum cleaner. It furnishes the energy for the range, water heater and toaster and for the heating pad when sickness arrived. This energy when transformed into light drives away the gloom and makes the farm house a home.

We have been talking about today. What will tomorrow bring? To help answer this question an investigation of national character has been organized and carried on for over two years. Many states have committees at work attempting to learn all about the ways that electricity may be utilized in agriculture. Even though California agriculture makes such extensive use of electricity, such a committee has been at work here for over a year. In this group are representatives of farmer organizations, such as the Farm Bureau, power companies, electric appliance manufacturers, and the College of Agriculture of our State University. They are meeting on a common ground and working on a common problem.



Over 80 per cent of the electricity used on farms in California operates electric pumps. The deep well turbine shown here is a type of pump of fairly recent development and particularly adapted to the higher lifts and seasonal fluctuations in ground water level.

YESTERDAY: The slow ox team, the candle and kerosene lamp, the many trips to the well with its hand pump, and the sad iron.

TODAY: The tractor and electric motor, the electric light, the automatic water supply system, the electric iron.

TOMORROW: Who dares to prophesy what electricity has in store for agriculture?

How "Pacific Service" Blazed the Trail

Rural Electrification Had Its Beginning in the Solution of the Hydro-electric Long-distance Transmission Problem

By FREDERICK S. MYRTLE

Rural electrification in the territory covered by the Pacific Gas and Electric Company's operations dates back to the late 'nineties, when the nucleus of what is now known far and wide as "Pacific Service" was formed by pioneer work in the field of hydro-electric development and the transmission of hydro-electric energy at high voltage from the points of generation, first, to nearby communities and, later, to the great cities of San Francisco and Oakland and the bay region generally.

The pioneer work referred to lay in the construction of water-power projects designed mainly to supply electricity for illuminating purposes. Of these the Folsom power plant, constructed in 1895, carried electricity at 11,000 volts a distance of twenty-two miles to the city of Sacramento, whose law-abiding citizens welcomed the new arrival in gala style. Two years later Mr. John Martin, to whom and his associates is given the credit of pioneering in the long-distance transmission of electric energy at high voltage, constructed a water-power plant in Brown's valley, whence the mysterious current was transmitted a distance of eighteen miles to the city of Marysville. Here the carrying pressure was set at 17,500 volts. Following this Mr. Martin built the still important plant of Colgate, on the Yuba river, and here really high voltage was tried for the first time. The first line was built into Sacramento, a distance of sixty miles, at 34,000 volts, and soon after that a separate line was built from Colgate to a distributing sub-station at Davis and thence on to Oakland, this latter being the first installation of the subsequently popular 60,000-volt transmission.

It was not long, however, before the commercial value of electric energy thus transmitted across country began to make itself felt. The problem of building transformers of sufficient capacity to "step up" the electricity generated at comparatively low voltage to a voltage sufficient to carry it over the wires to the point of distribution, where by another transforming process the high-voltage energy could be "stepped down" to a voltage low enough for distribution purposes, had been solved at the time the Folsom plant was built. It became, then, merely a question of tapping the wires on their cross-country journey. That accomplished, the rest of the story is one of gradual progress and development.

Mr. Martin believes that he put in one of the first, if not *the* first installation of an electric motor for agricultural purposes. He states:

"In 1898 Mr. J. P. Onstott, a farmer just outside of Yuba City, was irrigating his land with a pump worked by a gas engine. I persuaded him that a small motor would be found more efficient as well as of a considerably greater capacity. He acted on my advice and I installed a motor for him. It was a small one, I remember, and operated an old fashioned walking-beam pump. The centrifugal pump, of course, was a creation of a later day. The installation proved a success and led to others soon afterward. Incidentally, I remember that Mr. Onstott was the first man to plant the Thompson seedless grape in that section of California."

Men whose memories carry them back to those days say that the Sacramento valley was, for the most part, planted to hay and grain, and the necessity for irrigation did not take hold of the farmer until fruit cultivation became the vogue. As it was, the progress of the electric motor in agriculture was slow indeed for awhile. Even fifteen years ago the Pacific Gas and Electric Company's agricultural "load" was negligible. Just about that time, however, our company got busy, and the first thing done to draw the attention of residents of the Sacramento valley and elsewhere in the interior of California to the availability of electric power for agricultural purposes was the construction of a traveling exhibit in the form of a railroad

car supplied by the Northern Electric and run over its lines. Its interior was fitted up by our company with working models of electric motors and pumps and various other devices for the use of electricity on the farm. This demonstration car traveled altogether upwards of 500 miles and entertained, on an estimate, 6000 people. It is worth while, perhaps, to quote from the "Pacific Service" booklet issued for distribution to visitors to the car:

CHOOSE ELECTRICITY!

Irrigation by electrical pumping is superior to any other method because:

The water is under complete control of the land owner.

The irrigator is not dependent on his neighbors.

The water is flowing in an instant, day or night.

The machinery has no complicated parts to keep in repair.

There are no boilers to explode.

There is no gasoline tank to catch on fire.

It is cheaper to install.

It costs less to operate.

The cost of electricity is growing less every year.

It is easily and quickly started.

It is on the job day and night.

It brings power to the barn for doing the chores.

It brings light for sudden emergencies.

It brings a lower insurance rate on barn and house.

It brings a cool breeze for the hot summer day.

It brings a gentle warmth for chilly spring or autumn days.

It brings a soft, pleasing light for the long winter evenings.

It makes the Sabbath a day of rest for the housewife.

It brings the possibilities of dainty dishes for the invalid.

It brings more profit, comfort and pure joy of living to the farm than any one element of life.

The slogans of that day are the accepted facts of this. At that time (1911) the Pacific Gas and Electric Company furnished electric service to 187 towns, with an aggregate population of 1,081,222, while today our company supplies electricity to 289 cities and towns, with a population of 1,740,780. At that time our "Pacific Service" operated eleven hydro-electric plants in the mountains; today it operates twenty-eight. It is safe to say that the application of electricity to agriculture throughout our "Pacific Service" territory has played its part in this increase. The record for the past ten years may be taken to give the reader an idea of the constant growth of this clas of service:

In 1915, the company's agricultural load was 50,701 horsepower; in 1916, 63,193; in 1917, 70,318; in 1918, 78,491; in 1919, 110,150; in 1920, 141,449; in 1921, 149,-101; in 1922, 156,814; in 1923, 162,496; in 1924, 176,347; in 1925, taking the record as of July 31st, we find 190,458 horsepower in agricultural motors depending on "Pacific Service," with 10,057 agricultural consumers distributed among the eleven territorial divisions in which electric service is furnished by our company.

These results have not entirely come about of themselves. The farm problem is one of never ending investigation and research. The campaign of education is in progress all the time. Addressing the National Electric Light Association Convention in San Francisco last June upon the subject of "The New Era in Agriculture," the United States Secretary of Agriculture Wm. M. Jardine said: "The farm offers the greatest potential opportunities open to the electric industry. Electricity, in turn, offers to agriculture vast potentialities for the development of more efficient farming and a more permanent agricultural and rural system. Agriculture and the electric industry can eventually convert these possibilities into realities by coming to a mutual understanding of difficulties and by co-operating in sound investigation and in careful application of results." Such, indeed, has been our company's policy and upon which its success has been built.

In fostering the development of rural electrification it has been necessary for our company to be constantly anticipating future requirements, always alert to sudden changes and accommodating its resources to the constantly shifting demands of this newest phase of the world's oldest industry. For instance, in establishing a new service the Pacific Gas and Electric

Company will expend an amount equal to five times the estimated annual revenue to be derived from the extension. In arriving at this figure the company uses as a basis its experience with each type of electrical equipment and assigns to each the revenue that may reasonably be expected from it. Ordinarily the revenue on a proposed extension justifies its construction at company expense. However, where the cost of the line exceeds the five-year revenue the consumer may advance the difference subject to refund in proportion to the revenue which may be added by the connection of new or additional load to the original extension.



"Pacific Service" electric demonstration car

The farmers' operating cost is covered by a special agricultural rate. This rate is so constructed that the unit cost per kilowatt hour decreases approximately in proportion to the increase in consumption on any given appliance or motor. The rate schedule is constructed to so closely follow the actual cost of the energy that it is possible for a farm installation to earn a rate that is actually below the company's cost to serve. Thus, through the interrelation between the extension policy and the rate that forms its basis, the company first places a premium on the heavy installation of electrical equipment in order to justify a free extension and, in the second place, puts a premium upon the continuous use of the equipment in order to secure a low unit cost per kilowatt hour. The latter feature, however, so controls the former that over-installation in single units of equipment is penalized. The net balance between these two opposing factors tends to induce the consumer to add to his gross revenue for line extension purposes by segregating and diversifying his additional load, since the estimated five-year revenue from an electrical appliance or motor considerably exceeds the initial cost of the equipment.

Various changes of importance are constantly being made to further the development of the company's agricultural load. The same sympathetic interest that characterized "Pacific Service" during the pioneering days in rural electrification has been extended into the present period of intensive development.



Interior of the electric demonstration car

To attempt to set forth in detail, within so limited space as that at the editor's disposal, the many and varied activities of our company in promoting rural electrification throughout our "Pacific Service" territory would be an impossible task. The articles which follow this are presented as depicting peculiar conditions which have been met in selected sections and as going some way toward illustrating the charm of variety which makes north-central California the agricultural wonderland it is.

In the Sacramento River Country—Yolo District

A fair example of the tremendous strides made in rural electrification in various sections of our "Pacific Service" territory is furnished by the Yolo district. Looking back over a period of fifteen years, we find that the irrigation load in this district in the year 1910 was negligible. In the latter part of that year the first extension of any length was made for a line built from Woodland to Knights Landing to serve that town, and also, to supply a reclamation pump that was installed for Reclamation District No. 787. This is now owned practically by the River Farms Company.



Type of modern electric pumping plant for farms of from 50 to 100 acres. The water is secured from wells.



20 horsepower plant on H. O. Harrison ranch near Woodland.



Sutter Basin Company's plant at Tisdale Weir

From that date up to the present time the lines have been extended over or to take care of the agricultural load, and now our company has a connected load in Yolo district for agricultural purposes alone of 22,548 horsepower, out of a total connected load of 25,429 horsepower, as of August, 1925 and this may be contrasted with the total connected load in the district in 1910, which was in the neighborhood of 1000 horsepower.

It may be said, too, that the figures given of present load do not represent the load that our company may be called upon to serve in the near future, for the reason that a considerable acreage in the Yolo district is given over to rice cultivation and during the past season the rice irrigation plants were not run to full capacity. As a matter of fact, it is estimated that between 3,000 and 4,000 horsepower in motor installation in these rice plants was not made use of.

The type of motor, of course, has changed during the years. Of the plants that were installed in 1910, quite a few were of the belted type, while in later years most installations have been direct-connected units. Modern types are found in small as well as larger installations. Take for instance, the Woods 25 horsepower pumping plant which is located four miles north of Woodland. The equip-



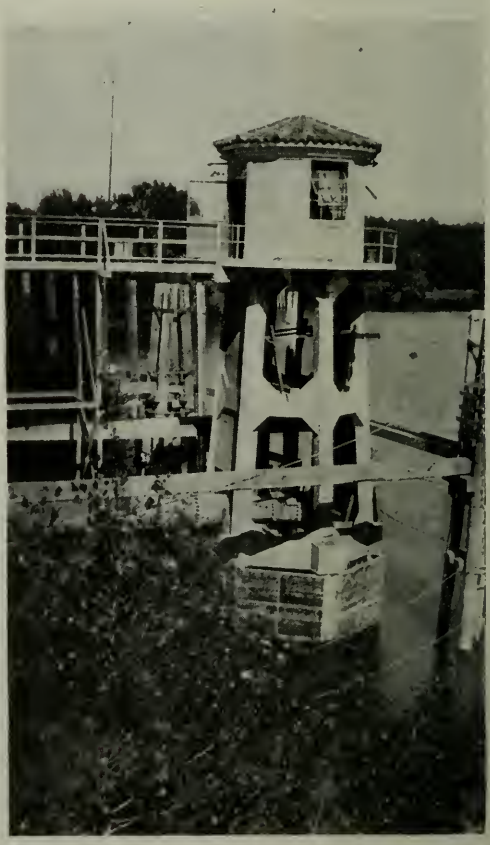
State Ranch Bend plant of Sutter Basin Company, 200 horsepower capacity.

ment there is installed in a concrete pit. In such instances the depth of the pit varies upon the distance it is necessary to travel in order to find water, as it is desirable to set the pump down as close to the water as possible in order to decrease the suction head. In Yolo county territory, as a general thing, the water level is fairly close to the surface of the ground, and at the Woods plant there is an 8-inch pump which is driven by the 25 horsepower motor referred to. A unit of this size is large enough to supply water for about 100 acres of alfalfa.

Another small installation of modern type is the 20 horsepower plant installed on the H. O. Harrison stock ranch, one mile north of Woodland. Here there is an 8-inch pump installed.

Among the larger installations in the territory are the plants of the Sutter Basin Company located near Knights Landing. The main pumping plant is of 1650 horsepower capacity, and is located on the east bank of the Sacramento River, directly adjoining Tisdale Weir. This plant has a pumping capacity of 300,000 gallons per minute, and supplies a territory of 40,000 acres in extent with the aid of ditches. There are six units in the installation. Another pumping plant, operated by the same company, is located at the State Ranch Bend, on the Sacramento river, at a point of about five miles north of Knights Landing. This plant is typical of the modern installations that are made along the Sacramento river, for the pump is installed in a concrete pit set into the levee, which protects it from the river water. This particular plant is equipped with a 200 horsepower motor and has a pumping capacity of 18,000 gallons per minute. It is connected to a ditch system which supplies approximately 5,000 acres of land.

An interesting installation is that at the Conaway ranch, which comprises a tract of land of about 20,000 acres located southeast of Woodland and extending from the Sacramento Northern Railroad to the Southern Pacific, a distance of approximately eight miles. Water for irrigation is taken from the Sacramento river at a point seven miles east of Woodland



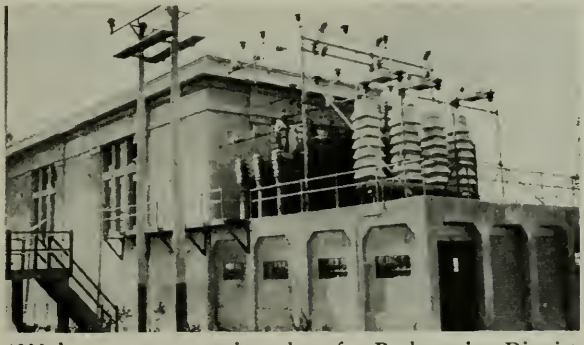
200 horsepower pumping plant on Meek estate, Knights Landing, Yolo County.

and is carried through a system of ditches to what is known as the "booster" plant, at which point the water is again pumped into a reservoir whence it is diverted to the land. The plant at the river is equipped with four 300-horsepower vertical motors directly connected to vertical pumps located at a point near the low water level of the river. This is a very compact as well as neatly arranged installation. The booster plant contains three horizontal units direct connected to the pumps, and the capacity of the motors installed therein aggregates 800 horsepower.



Electrically operated pumps sometimes supply an entire irrigation district with water.

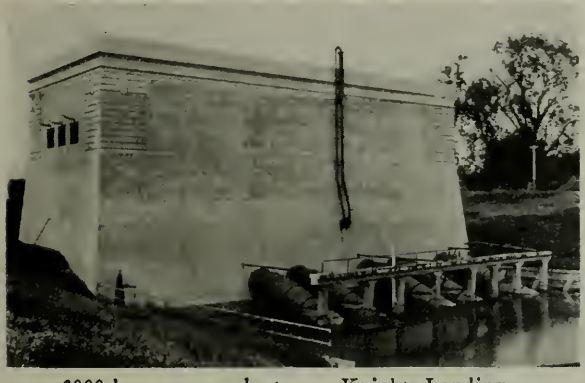
Another installation of vertical equipment is at the plant of the Meek Estate, where the plant is constructed upon piles driven into the Sacramento river. The installation consists of three units, totaling 200 horsepower capacity, and the water is carried in open ditches to the point of distribution, approximately two miles south of Knights Landing.



4800 horsepower pumping plant for Reclamation District No. 1500, south end of Sutter Basin.

On the west side of the Sacramento river and extending from a point opposite Tisdale Weir to a point near Knights Landing lies a large tract of land, the major part of which is owned by the River Farms Company. The tract is about 30,000 acres in extent and the greater part is irrigated by eight pumping plants installed at different points.

The exact figures are not available to show the total acreage covered by the various pumping plants installed in the Yolo district, but it is safe to say that it exceeds 100,000 acres.



3000 horsepower plant near Knights Landing, Reclamation District No. 108.

Electric power also does yeoman service in the reclamation projects in Yolo district, where pumps are used during the rainy season to draw off rain and seepage water. Some of the largest reclamation districts in California are in this territory, among which are Reclamation District No. 108, where the pumping installation is rated at 3000 horsepower capacity, and District No. 1500, where there is an installation of 4800 horsepower capacity.

Irrigation on the West Side— The Glenn-Colusa District

During the early nineties the late Will S. Green, who then resided at Colusa, conceived the idea of an irrigation system for the county of Colusa, which in after years was divided into the present counties of Glenn and Colusa. The irrigation canal was planned to tap the river just north of Stony Creek and extend in a southwesterly direction for a distance of approximately fifty miles, capable of irrigating about 120,000 acres.



Rice camps are liberal users of electric power

This system was never completed during the lifetime of Mr. Green, but actual construction work was started and a number of miles of ditch actually built. Money for the purpose was not available at the time, so the work was temporarily abandoned until the canal company was purchased by the Sacramento Valley Irrigation Company, which was later united into the Glenn-Colusa Irrigation District. This system is one of the largest in America and primarily consists of a large pumping plant at the headwaters of the canal known as the Headgate, where the water is pumped by electrically operated motors from the Sacramento river and delivered into the canal.

The connected motor load of this plant is about 3,000 horsepower, which delivers about 1300 second feet of water into the canal. This irrigation project has turned thousands of acres of arid land of Glenn and Colusa Counties into green fields of rice, alfalfa, corn, and orchards.

With reference to the cost, we find that the general crop cost per acre per year is $1.00 and the bonded debt of the district less than $19.00 per acre, by far the lowest of any irrigation district in California. The district's greatest asset is an unassailable, prior Congressional right to water from the Sacramento river, which has its source near Mt. Shasta. The stream is also fed by the Pit river, which guarantees a continuous flow throughout the year.

There are two other extensive irrigation systems operated in Glenn County. One known as the Princeton-Glenn-Codora Irrigation District and the other the Provident Irrigation District. These two districts supply water for some 25,000 acres, and operate similar electrical pumping plants located along the river. These, however, are not as large as the Glenn-Colusa District.



Dehydrator for drying prunes on George Morgan ranch at Corning. 25 horsepower in motors.

An accompanying illustration shows a cotton field in Tehama county, near the town of Gerber. The growing of cotton is largely in an experimental



Cotton field in Tehama County. Irrigated by water pumped by electric motors from the Sacramento river and wells.

stage, as yet, but that those behind this and other enterprises of its kind feel confident of its success may be gathered from the fact that there are three cotton gins already established in this section of Northern California, one at Maxwell, one at Chico and the third at Oroville.

The factory of the Sacramento Valley Sugar Company, located at Hamilton City, Glenn County, is one of the largest industrial factories of Northern California. The plant has an ideal location near the center of the northern part of the Sacramento Valley where the soil is well adapted to the growing of sugar beets.

The harvesting of beets usually begins about the middle of August and extends to almost the first of November. The plant runs continually from the time it opens until the beets have all been harvested. After the beets are delivered to the factory, the process of converting them into sugar requires four distinct operations. The first is known as the diffusion, where the sugar is extracted from the beets; the next step is the carbonation where the extract or juice is treated for filtration, which is the next process; then the evaporation, while the last is the crystallization, after which the sugar is sacked and ready for the market.

The by-product from the beet is known as pulp and is an excellent feed for cattle or can be used as a fertilizer.

Approximately 400 horsepower in electrical motors has been installed in this plant. "Pacific Service" also provides irrigation for the growing beets by operating numerous pumping plants located along the Sacramento river.



Sacramento Valley Sugar Company, Hamilton City, Glenn County

Altogether, then, the uses of electricity in the stretch of country reaching down the west side of the Sacramento valley and following, generally, the course of the Sacramento river are many and varied.

Electric power is proving itself the almost indispensable agent of modern irrigation.

In the Footsteps of the Padres
The Valley of Santa Clara



Pumping plant in the Santa Clara valley

Great strides are being made in the use of electricity for agricultural purposes in the Santa Clara valley. It is safe to say that more electrical plants for the advancement of cultivation as well as the comfort of the farm home are installed in this beautiful and historical section of Northern California than can be found anywhere else in the world in a similar expanse of territory.

Irrigation is in progress throughout this spreading orchard country and the electrical pump is fast displacing other sources of power. Take some instances of some modern installments:

Mr. Arthur Clay, whose ranch is on Norwood Avenue, near Evergreen, has an electrically equipped home, using electricity for lighting and heating, as well as an electric range for cooking. He is satisfied to the point of enthusiasm because of the economy, cleanliness and comfort he derives from his use of the mysterious energy to say nothing of increase in efficiency. There is an electric pumping plant on the Clay ranch which is used for irrigating not only his own place, but that of several smaller holdings adjoining his. The water is pumped from a well 364 feet deep, with a capacity of 880 gallons per minute, and irrigates in all 275 acres of orchard.

Mr. Fred Holthouse, who lives on the Mountain View-Alviso road, irrigates his farm with a 50 horsepower vertical pumping plant. He also uses an electric range on which meals are cooked for twelve persons at each meal daily. Mr. Holthouse has made a very careful check on the cost of operation by electricity and has found it very much cheaper as well as more efficient than any other method of irrigation.



50 horsepower pumping plant in peach orchard near San Jose

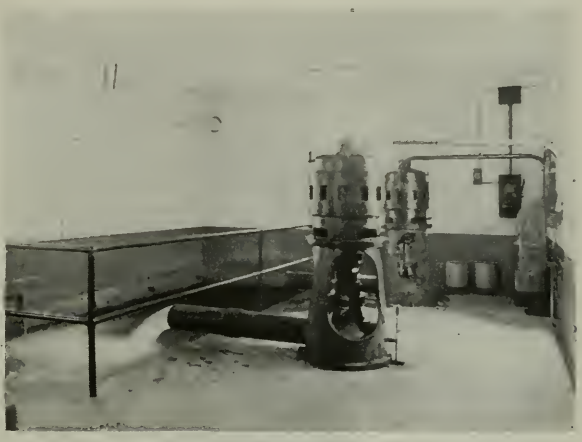
On the Sheriff's ranch, Edenvale, there is a 40 horsepower pumping plant. This is a new installation. It is a vertical pump and irrigates 96 acres of orchard.

The Los Altos country club has a deep well and electric pumping system which takes care of the entire club reserve, including all sprays on the golf course.

Another installation of interest is at the Hester

dairy, San Jose. Several pumps are in use there, including a sump pump close to the dairy buildings. So well pleased are these people that they are planning to have everything on the ranch operated by electricity.

These are only a few of the places in Santa Clara county where electricity is used to very great advantage. There are several large installations, but frequently it is the smaller installation that serves best as an illustration of the economy as well as the efficiency of rural electrification. A prominent instance was furnished just about a year ago, when Mr. Carl Tuttle, who operates a 21-acre dairy on the Trimble road in the famous Santa Clara valley, not far from the city of San Jose, reported that with the aid of a 2 horsepower motor and a patent electrical milking machine he was milking thirty-one cows quicker and better than when two men were employed to do this work. Mr. Tuttle reported also that he had installed an electric range, electric washing machine, electric iron and other labor saving appliances and in five months his bill for electricity averaged only $13.16 per month. These figures are offered in contrast to the cost of manual labor.



Interior of farm pump house where the installation is of high-class order.

Let us here enumerate a few facts concerning the distribution of electricity as an aid to progress and development in a valley section such as the Santa Clara. For instance, there are 34,272 poles owned by the Pacific Gas and Electric Company in the Santa Clara valley, a large proportion of which is used in transmitting electricity to agricultural enterprises. Added to these are 6,810 joint poles, that is, poles used jointly by the Pacific Gas and Electric Company and the Pacific Telephone and Telegraph Company. This gives us a total of 41,082 poles. Imagine for a moment what a forest these poles would make in their natural habitat and just as they were before the lumber-man found them, with limbs, leaves and all the natural growth intact!

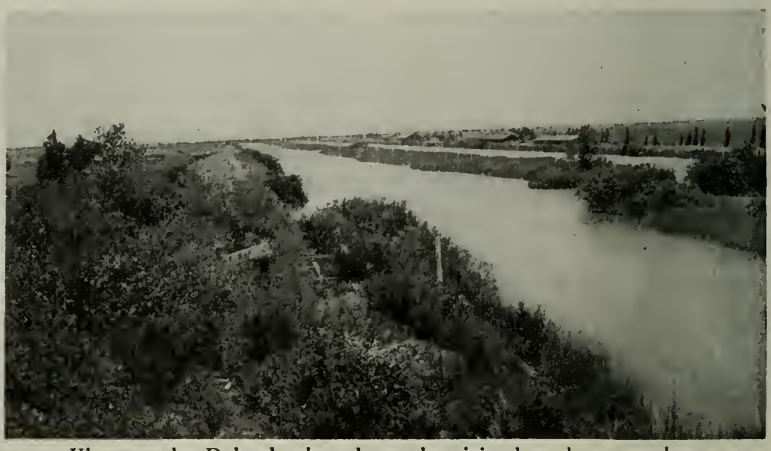
It may not be generally known that the Pacific Gas and Electric Company's overhead power distribution system in the Santa Clara valley reaches 1,138 miles of line. To be sure, this is not the progress of a day or night, but it really covers a comparatively short space of time. Again, it is of record that there are 28,588,080 feet, or approximately 5000 miles, of overhead line-wire used by the Pacific Gas and Electric Company in this same territory. These are facts which serve to inform us of what is involved in the distribution of electric power over an extent of agricultural territory. It may even be said in this instance electric power in agriculture, for the figures given here, cover almost wholly agricultural property.

Is it not a wonderful opportunity for large public utility companies to serve the people and to serve them in such a way as to invite their lasting gratitude as well as their good will?



Modern dehydration plant. ~~Heat~~ Power supplied by electricity.

As If By Magic—Transforming The Valley of the San Joaquin



View on the Delta lands, where electricity has done wonders in reclamation work

Our stage is set in San Joaquin and Stanislaus counties. Here we find agriculture at its best. At the beginning, two entirely different problems faced the pioneer. In San Joaquin county he set to work reclaiming the vast and fertile delta regions, removing water from the tule and peat lands, while in Stanislaus county he set about applying water to the desert-like soil. And now, following bitter hardship, failure and discouragement, these two sections have been converted into a garden spot, the counterpart of which can only be found in the ancient valley of the Nile. It is not hard to imagine the part played herein by electricity. The ever dominating spirit of the pioneer, coupled with the inexhaustible energy of this tireless servant, could not but produce magic.

The reclamation of the overflow lands is a real accomplishment. The lands in their original state were covered by rank growth of tule and other vegetation which decayed annually, eventually becoming buried under a deposit of river sediment upon which new vegetation quickly grew to be again overwhelmed. It took, perhaps, many centuries of formation to produce such a condition of fertility as could not be overlooked; but, there it was. The problem was one merely of water control.

The city of Stockton is about fifteen feet above the tide level of San Francisco bay, and the Delta region lies west of it. In its natural condition this entire territory is subject to overflow during the seasons of high water, and the greater portion of it is subject to overflow in its natural state from ordinary high tides. In order to bring it into its present state of successful cultivation it has been necessary to build levees around the different tracts and put in systems of drainage. This Delta region is 300,000 acres in extent and is cut up in every direction by rivers and sloughs, so that the reclamations have been made in a large number of units, the acreage of the unit varying from 300 to 500 acres as a minimum up to a maximum of 35,000 acres; the average unit, however, running from 4000 to 7000 acres.



Onion field on a Delta farm



Westside Irrigation District pumping plant and P. G. & E. substation. Seven pumps, totaling 1900 horsepower, lift water from San Joaquin River into two canals, irrigating 10,000 acres

The history of the reclamation of this territory goes back to the early sixties. In the beginning, practically all of the levee work was done by hand work and by horse scrapers; a great deal of the attempted reclamation in the lower territory was done by Chinamen with wheel-barrows. There are still occasional evidences to be found of this old work and, in some instances, where large sloughs were dammed, it is a matter of wonder how so much could have been accomplished by hand work.

The greater portion of the soil is of peat formation, the peat varying in depth from one foot up to a maximum of about forty feet. In flood times the high waters reached a level probably less than two feet above the surface of the land, so it was thought by early reclamationists that if they could put up small levees three to four feet high they would be able to keep out the water and cultivate the soil. Many thousands of acres in different tracts were attempted to be reclaimed in this way, and in the seventies hundreds of thousands of dollars were spent in putting up levees and attempts made to cultivate the land behind them. But all such attempts proved failures. The peat was of such a porous character and of such a light formation (being of such lightness that it will float on water) that the weight of this small amount of material put on the land for such purposes had the effect of compressing the foundation on which it was laid, so that the levee settled until it was impossible to keep it materially above the natural surface of the ground. Practically all of the reclamation undertaken under these conditions resulted in an absolute failure, and it was soon realized that different methods of reclamation must be adopted before any success could be



Interior of Westside Irrigation District pumping plant



Upper main canal Westside Irrigation District, south of Tracy

made in farming these lands. As a result, in the early eighties, the clam-shell dredger came into existence as a practical proposition in this territory and a start was made in constructing levees with these machines.

Further difficulties, however, developed, as it was found that the additional weight of material put onto the peat soil by the dredger only aggravated the settling tendency, so that the material disappeared about as rapidly as it was put up. As time went on, however, improvements were made in the clam-shell dredger until, about 1892, the improved clam-shell was developed into its present state of efficiency, the only material difference being that whereas in those days the clam-shells were built with 75- to 100-foot booms, carrying 2-yard buckets; many are now built with 225-foot booms, carrying 6-yard buckets. With the advent of the improved clam-shell (and incidentally, with the growth of the State, a greater demand for good land) a great impetus was given to reclamation in the Delta territory, and since that time it has progressed so rapidly that practically all of the available land in that extensive region is now well reclaimed and under cultivation.



River plant of Byron Bethany Irrigation District. Electric motors, one 500 and one 300 horsepower, raise water in the first of a series of lifts to supply approximately 9000 acres of land. "Pacific Service" supplies the power, and its substation and transmission line are seen in the background

In these early days, the only power that was available for pumping purposes was steam, and it was not until about 1900 that gas engines came to be used, and these, in the stage of their development at that time, were very unsatisfactory. The installation of a steam plant was very expensive; fuel oil had not come into general use and the steaming was done with coal which had to be shipped and reshipped to get it to its destination; all of which made it very difficult and expensive to maintain satisfactory pumping facilities sufficient for the necessities of the reclamations.

The advent of electricity revolutionized the drainage system of the entire reclaimed territory. In 1906 the first electric pumping plant was installed at Middle river on the Old Jones tract, a reclamation of 6300 acres belonging to the Rindge Land and Navigation Company. Power was furnished by the Pacific Gas and Electric Company. Mr. Lee A. Phillips, who at that time was manager for the Rindge Land and Navigation Company, keenly appreciated the need of better pumping facilities in order to get best results from the land, and the first system of complete drainage on any reclamation in



Pumping plant No. 3, Pescadero Reclamation District

this territory, both in the way of ditches, canals and pumping machinery, was inaugurated by him on the Jones tract. This was the beginning, too, of the real successes in the reclamation of the lower lands. Larger levees were being constructed everywhere, and when it was found that electricity would insure efficient and ample pumping facilities the work of reclamation developed very rapidly. Since that time, practically no other power has been used for reclamation purposes anywhere in the Delta region.



Gates in pipe-line of Pescadero Reclamation District plant No. 3. The water flows from the San Joaquin River into a dredged slough through the center of this tract and is pumped out at different locations by ten plants all supplied by "Pacific Service." The tract is being rapidly developed into modern dairies and alfalfa and cows are replacing grain land.

To the south of the delta lands, the situation was quite different. The lack of water had created a vast area of desert waste; so, the pioneer here faced the problem of applying water to the land. As gravity flow was available only in rather limited areas, pumping plants electrically operated were located upon the banks of the rivers and, under control of irrigation districts, water was made available to thousands of acres of land served from a golden network of canals.



El Solyo ranch and dehydrator. Vineyard of Thompson seedless grapes in foreground

With the abundant application of water through gravity irrigation a new problem presented itself, first merely as a drawback or weakness, finally as a menace to crop production. A condition of excessive sub-irrigation was discovered in places where the water plane was high due to lack of under-drainage. This condition, however, has been alleviated to a large extent by the installation of individual electrically-operated drainage plants for the purpose of removing water from the land and, at the same time, lowering the water table, thereby removing acidity from the soil.



Irrigation canal, El Solyo ranch

Agricultural development over the entire San Joaquin division has made unusual progress during the present year. Large sums are now being expended by investment companies to develop new land and, at the same time, to reclaim those valuable lands which need drainage systems. The table which follows gives an idea as to the re-

cent development in the Stockton district:

	AGRICULTURAL MOTORS	ALL OTHER MOTORS
Oct. 1, 1925	28955.5 H.P.	3045.5 H.P.
Jan. 1,1925	24591.0 H.P.	2952.5 H.P.
INCREASE	4364.5 H.P.	93.0 H.P.

3369.5 H.P. of this increase was added in the Tracy territory alone causing much reconstruction and quite radical changes in the operation of our 60 KV system.

The Banta Carbona Irrigation District connected six plants, aggregating 3104 horsepower to our system during September, which will provide water for the irrigation of 41,000 acres located southeast of Tracy. This undertaking was made possible by the foresight, courage and resourcefulness which have always been characteristic of the western pioneer and will make it possible for this vast area, heretofore capable of producing only dry farm crops, to come into its own, thereby increasing its productiveness and providing homes for hundreds of new settlers. The cost of pumping plants, ditches, gates and other expenses is covered by a bond issue against the land.

In order to serve this load, 4000 feet of new 60 KV line was built, approximately 12 miles of line was replaced with larger wire, a 60 KV sub-station was installed as a distributing point for the six plants involved, and additional switching equipment was installed at West Side sub-station. The general construction department handled this job at an estimated cost of $37,000. The estimated annual revenue from this project promises to make it one of the best consumers on our lines.



Moreing and Moore dairy, near Tracy. "Pacific Service" furnishes dairy power and to pump water for alfalfa and other feed. This dairy averages 1500 gallons of milk daily supplied to San Francisco creameries.

Shortly before the first of this year the Burkhart Investment Company requested us to serve them with 335 horsepower to be installed in seven plants located at favorable sites on property which they are interested in. Necessary facilities were made to serve this applicant by reconstructing one and one-half miles of 11,000-volt line with larger size wire, and constructing five and three-quarter miles of new line.

These two irrigation projects, combined with the Patterson Water Company system and other large private plants, have made an extensive part of the West Side territory productive. Those lands nearest the mountains and areas around Westley and Vernalis are the less intensively cultivated.

The Patterson Water Company has nine plants with a connected load of 2222 horsepower which is distributed throughout Patterson colony. "Pacific Service" supplied the colony with 2300-volt service.



Flumes and electrically-driven pumps are often combined for the irrigation of distant fields.

Adding to these three rather well known developments those pumps which belong to private parties, we find that there are sixty-five major plants and numerous smaller plants in operation, making a total of 31,178 horsepower used for land development on the West

Side. With the help of "Pacific Service" is added another section of productive land for the feeding of the people of the United States and the world.

It is a long step from the early days of development to the present day condition of wealth and prosperity. Yet we have but started to develop. We have learned to do bigger and better things. We now recognize electricity as a necessity, for we know that there is no place in this rural environment where electric power cannot do farm labor better and cheaper than any other agency.

Agriculture is allied to many interrelated industries, such as, for instance, creameries, canneries, and even farm implement manufacturing plants. To really appreciate the interrelation, one must travel from the metropolitan region to agricultural cities, such as Stockton and Modesto. Here we see industrial developments where electricity is the dominating power. We find such institutions as milk condenseries, tractor manufacturing plants, canneries, ice manufacturing plants, these various and diversified industries having a connected electric motor load totaling thousands of horsepower. The dairying industry contributes much to these plants, it being realized, of course, that Stanislaus county is the leading cow county of the State and is second in butterfat production by counties throughout the United States.

The farmer is the main contributor to the support and upbuilding of our little cities, for, while he lives on the farm and occupies himself with the production of crops or cattle or both, yet it is in the city that he buys his electric range or water-heater, his electric feed chopper, his electric pumping plant, his electric dairy sterilizer, and a multitude of other electrical devices. The farmer appreciates electricity. It has solved his farm labor problem. He cherishes the convenience and cleanliness of the milking machine and the electric sterilizer. His farmyard is well lighted at night. He has domestic water available under pressure from his electric pressure pump. Mrs. Farmer cooks electrically and heats her home electrically in the winter. Electricity has brought the conveniences of city life to the farmer.



Electric pumping plant on San Joaquin Valley ranch



Where water is pumped from the San Joaquin River to supply the Patterson irrigation system on the west side of the San Joaquin Valley

This cross-section of our territory will remain practically constant. More and more electricity will be required. The power company is an indirect partner in all these development enterprises, bearing the burden of pioneering and sharing the prosperity of the territory which it serves.

Where Foreign Plants are Nurtured— The U. S. Gardens near Chico

A government enterprise of particular interest to the tiller of the soil in California, and in whose maintenance and operation "Pacific Service" plays a modest but not unimportant part, is found at the United States Plant Introduction Gardens, near Chico, Butte County.

These gardens were established in 1905 and were the first and largest government-owned and operated gardens of their kind in the United States. Their location at Chico was decided upon, after an exhaustive survey of this country by the United States Bureau of Plant Industry, as being the most adaptable from the standpoints of soils, climate, etc., for the establishment of gardens for the introduction and propagation of foreign trees and plants. For this purpose the Bureau of Plant Industry employs plant experts in many foreign countries, such as, for instance, Asia, Africa, South America, Australia and China, who are on the alert at all times to secure species of plants and seeds which, in their judgment, might prove of commercial value if introduced into the United States. Plants and seeds when secured are sent either to Chico or to some one of the five other Introduction Gardens in the United States, located, respectively, at Miami and Brooksville, in Florida, Bell, in Maryland, Bellingham, in the State of Washington, and in Savannah, Georgia. The selection of any particular one of these gardens depends largely on the character of the plant.

The Chico station, which comprises 209 acres of land, has been very successful in introducing foreign plants. For example, two hundred and forty varieties of grapes, forty varieties of cotton and one hundred varieties of figs have been turned out from the Chico gardens; besides these, the pistache nut and many varieties of citrus and deciduous fruit trees have been imported from foreign countries. Plants and seeds are distributed in large quantities every year, with full instructions concerning the best methods of planting and care of the growing plants. The station maintains a staff of experts in agriculture, horticulture, and viticulture, and they are ready at all times to offer suggestion and advice on any of these matters from their practical experience and years of study. Application for plants and seeds introduced at the Chico gardens can be made to the Bureau of Plant



Bamboo forest in the U. S. Gardens at Chico



The greenhouse and nursery at the U. S. Gardens. Jujube plantation in foreground.

Industry, United States Department of Agriculture, Washington, D. C.

As stated, the gardens are 209 acres in extent. Six hot-houses, together with office and residence buildings, comprise the structures. Of special interest is the seed bed, which is protected by a structure having a channel-lathed roof, which serves to carry off rainfall and prevents drippage. It is understood that there is but one other structure of this kind in California. The entire tract is under irrigation, the greater part of it under a pressure system. "Pacific Service" plays an important part in developing the thousands of varieties of plant and tree life introduced for the benefit of the citizenship of the United States. There is an electrical installation for pumping service of approximately 30 horsepower.

The illustrations which accompany this article serve to show something of the unusual on display at the gardens. One shows a bamboo forest or jungle. This is the timber bamboo of Japan and the natives of that country use it in the construction of their houses, ladders, buckets, furniture, etc., also, to make water pipe for irrigation purposes. The largest of these canes have made their growth since May this year. Some of them tower sixty feet into the air and are from three to four and one-half inches in diameter. Notwithstanding this rapid growth, however, it takes about twelve years to grow this variety of bamboo to maturity. It may be utilized for food. When the canes are just emerging from the ground they may be cut in cross sections and cooked.



Specimen of the better variety of jujube tree

Another subject of particular interest is the work being prosecuted at the plant gardens in the introduction of the Jujube or Chinese date. This re-

sembles the date we know in flavor and appearance and because of its adaptability and climatic conditions it is expected to achieve great commercial value in this country. The plants which are shown in the accompanying illustration were grafted about April 1st and have made a growth of from four to six feet. They are abundantly laden with fruit, showing the very great precociousness of this plant.



An acre of cotton, including some forty varieties

Another point of interest at the gardens is found in one acre of cotton, in which there are forty varieties which have been tested at the Chico station during the past seven years. Many of these varieties have shown promise, the acola, in particular, having proved quite adaptable to soil and climatic conditions in the northern part of California.

Another illustration accompanying this article shows varieties of opuntia, an edible fruit largely used by the natives of Mexico. The fruit in addition to being utilized for eating purposes is made into a drink which is quite popular with the Mexicans. Some of the varieties are spineless and may be used for stock-food purposes.



Varieties of opuntia on view at the gardens

(We are indebted to Mr. I. B. Adams, manager of the Sabla division, for the foregoing article, with accompanying illustrations.—ED.)

"Pacific Service" in the Chicken Country

Electricity is rapidly becoming extremely popular in the poultry district. Its advantages include great desirability as a source of heat, an absolute automatic control requiring no attention whatever, and continuity of service provided by the power company.

Temperature control is by means of a thermostat which contains an exact temperature for incubators and brooders. The capacity of the average incubator is about 500 eggs, and the capacity of the average brooder from 250 to 300 chicks. The connected load runs from about 300 to 500 watts to each incubator or brooder and the consumption approximately 24 kilowatts in ten days.



Type of electrically-heated brooder

In the vicinity of Petaluma, in the North Bay division of our "Pacific Service" territory, it is estimated that our company has installed a power load exceeding 2000 horsepower operating small motors of from one-half to five horsepower capacity on poultry farms. These installations include motors for pumping water to irrigate green feed—many of them applied to pressure systems,—motors for cooking and mixing poultry feeds, motors used to operate conveyors for distributing feeds and hauling eggs into the packing rooms, electric heaters for sprouting certain grains for growing chicks, electric heaters for keeping required temperatures in cold weather where hatching eggs are packed; last, but certainly not least, motors for operating brooders and incubators. The last two named uses are the most important, and for these our company has upwards of 1500 horsepower connected with chicken farms in the Petaluma district.

Electricity is also used for artificial light in hatcheries. It is estimated that over 50 per cent are lighted artificially for four months of the year. The standard requirement for this purpose is one watt per fowl. These lighting systems are operated by automatic time switches so that the farmer can sleep while his hens are scratching and laying in the artificial daylight.

The Must Hatch Incubator Company, at Petaluma, operates the largest electrical hatchery in the world. The owner and proprietor studied the hatchery problem both in this country and in Europe before pronouncing himself sold to the electrical idea. He has been quoted as saying: "Hatching by electricity is the last word in artificial incubation."



Interior of hatchery at Petaluma, operated by electricity

Irrigation by Overhead Sprinkling

By H. A. WADSWORTH
Assistant Professor of Irrigation Investigations and Practice,
College of Agriculture, University of California.

Although the irrigation of orchards and nurseries by means of an artificial rain is an old practice in many parts of the United States, this practice is of but recent popularity in California. Isolated installations of overhead sprinkling equipment were to be found in California prior to 1920; the vast majority of the present installations have been installed since 1924.

An overhead sprinkling installation is in the last analysis an effort to imitate a natural rainfall. Water is conveyed through the area to be irrigated in pipes and outlets are provided through which water may be dispersed in the coarse drops of a heavy shower. The height of the outlets above the ground and the number required per acre varies with the crop to be irrigated, the type of distributing head to be used, the size of pipe used in the underground distributing mains and the initial pressure available. With a well designed system sprinkler heads should be frequent enough to enable the watering of every foot of producing area.

Simple as this conception of an overhead sprinkling installation may be, it involves in its application some problems in pipe design and location which demand considerable care and judgment. If a single line in an installation is to carry six sprinkling heads at forty-foot intervals, each one of which is capable of distributing six gallons per minute under a pressure of fifteen pounds per square inch, it is essential that the last forty feet of this line be of a size sufficient to carry six gallons per minute without such a loss of pressure due to friction that fifteen pounds per square inch is not available at the lower end. The second forty-foot section from the end must carry twelve gallons per minute, the third eighteen gallons per minute. The first section of forty feet must have a capacity of thirty-six gallons per minute, and must be large enough to deliver this quantity without such losses of pressure that the heads lower on the line are unable to operate under the pressure for which they were designed.

Such problems require considerable knowledge of friction losses in small-sized iron pipe and access to carefully compiled friction tables. Most manufacturers and contractors for such equipment maintain engineering departments where expert advice as to required pipe sizes can be obtained. Iron pipe has the unfortunate property of accumulating scale which, in a few years, effectively decreases the internal diameter of the pipe and consequently reduces the capacity under a certain available pressure. An installation may be quite effective for the first few years of its life but inadequate after ten years because of scale formation. For long-time service a friction head table designed for use with pipes about ten years old should be used.

Permanent sprinkler installations are costly. A cost of three hundred dollars per acre for the installation of sprinklers on such a plan that the labor of applying water is reduced to that involved in opening a valve or starting a pump is not uncommon. Many growers are unable or unwilling to



Electrically-driven centrifugal pumps are often used to create pressure for the operation of overhead sprinklers.

accept such a charge. Semi-portable installations reduce this high first cost; but the labor involved in the actual application of water is increased.

With the semi-portable installation underground lines are laid through the area to be served at intervals of about one hundred feet. These lines are equipped with ordinary garden faucets at intervals of about eighty feet. Portable sprinklers, somewhat similar to that shown by the accompanying illustration are used to distribute the water. These heads are connected to the garden faucets by not more than fifty feet of garden hose. When the area available from a single setting is sufficiently irrigated the portable sprinklers can be readily moved to another location. The necessary underground piping can be greatly reduced if the irrigator is willing to undertake the labor of moving the portable sprinklers when necessary. The cost of such an installation including the underground pipe, the necessary hose and six portable sprinklers has been found to be about one hundred dollars per acre. It will be found that considerable saving in pipe sizes can be obtained if each lateral carries but one sprinkler in place of operating the six sprinklers from the same lateral.



The use of portable sprinklers fed by lengths of garden hose lowers the first cost of the installation.

A further economy in installation can be effected by the use of a portable lateral line from the main. This portable lateral is usually made of several lengths of two-inch pipe and is connected with the underground main by means of a short length of two-inch high pressure hose which can be connected to large valves on the underground line. Portable sprinklers are connected to this portable lateral with garden hose. Such portable installations including the sprinkling stands cost about eighty dollars an acre.

In some places, especially along the Sierra Madre foothill belt in Southern California, irrigation water is delivered under sufficient pressure to operate an overhead sprinkler system without the use of a booster pump. In other cases centrifugal pumps are used to create the necessary pressure. The accompanying illustration shows a single stage, electrically driven centrifugal pump which is used to give pressure for sprinkler operation. The suction pipe for this pump extends through the curbing of the pit into the low pressure pipe line which supplies irrigation water for the area.

Irrigation by overhead sprinkling is costly both in first cost and in operation, if, as in most cases, the necessary pressure must be supplied by pumping. But a satisfactory irrigation can be accomplished by this means even under conditions of most adverse topography and most difficult soil types. Intelligent management is still essential however. Even such a costly installation as those mentioned above cannot free the irrigator from the necessity of making frequent observations as to the presence of available moisture with soil auger or shovel.

The Financial Side of "Pacific Service"

Following is a summarized preliminary statement of the Company's income account for the third quarter of the year and for the twelve months ended September 30, 1925, compared with the same periods of the preceding year:

EARNINGS THIRD QUARTER TO SEPTEMBER 30TH

	1925	1924	INCREASE
Gross Operating Revenue	$11,841,754	$11,023,390	$ 818,364
Net Income	4,569,501	3,845,039	724,462
Bond Interest and Discount	1,868,477	1,595,449	273,028
Reserve for Depreciation	943,349	792,391	150,958
Surplus for Stock	1,757,675	1,457,199	300,476

EARNINGS TWELVE MONTHS TO SEPTEMBER 30TH

	1925	1924	INCREASE
Gross Operating Revenue	$47,051,602	$43,055,866	$3,995,736
Net Income	18,711,881	16,340,302	2,371,579
Bond Interest and Discount	7,361,101	6,597,002	764,099
Reserve for Depreciation	3,520,371	3,066,380	453,991
Surplus for Stock	7,830,409	6,676,920	1,153,489
ACCRUED DIVIDENDS FOR 12 MONTHS:			
On Preferred Stock (6%)	3,264,436	3,240,268	24,168
On Common Stock (8%)	3,505,310	2,923,792	581,518
Balance	1,060,663	512,860	547,803

Surplus in the twelve months' period to September 30, 1925, was equivalent to $10.47 per share on the average amount of common stock outstanding, and exceeded the 8% dividend requirement on common stock by $1,060,663 as compared with $512,860 in the twelve months ended September 30, 1924.

The net addition of new customers in the first three quarters of the year was 30,844, making the total number of meters in service on September 30, 1925, 794,461.

LIST OF PARTNERS IN "PACIFIC SERVICE" GROWS STEADILY LARGER

AVERAGE HOLDINGS DECREASE

Recently compiled statistics indicate that the average individual holding of this Company's stock continues to decrease steadily as the Company's securities are distributed among an ever widening circle of investors. In June, 1914, at the time of its initial direct offering of stock to local residents, the average number of shares held by each of the Company's 3,230 stockholders was 130.9. Eleven years later the average holding had diminished to 27.1 shares, while the number of stockholders had increased to 37,831.

STATEMENT SHOWING AVERAGE HOLDINGS OF STOCK
JUNE 3, 1914 TO JUNE 30, 1925

	NO. OF STOCKHOLDERS	NO OF SHARES OUTSTANDING	SHARES PER STOCKHOLDER
1914 (June 3)	3,230	422,846	130.9
1914 (Dec. 31)	4,675	509,106	108.9
1915	8,124	566,223	69.7
1916	8,273	579,878	70.1
1917	8,738	588,516	67.4
1918	8,733	590,077	67.6
1919	9,338	640,536	68.6
1920	14,620	676,891	46.3
1921	18,814	751,805	39.9
1922	25,890	858,994	33.2
1923	26,742	899,300	33.6
1924	31,859	972,703	30.5
1925 (June 30)	37,831	1,025,953	27.1

Complete statistics as to the number of holders of the Company's secured obligations are impossible to obtain. Details are available, however, with respect to $91,-251,500 par value of bonds which are held by 35,613 individuals, representing an average investment of $2,562. The total number of the Company's bondholders is estimated to be approximately 45,000, making the aggregate of all of its security holders somewhat in excess of 82,000. These figures are, of course, subject to some modification due to duplications on account of the same investor holding more than one class of security. On the other hand, the number of persons having an indirect financial interest in the Company's securities, through the investments in these issues of savings banks and insurance companies in which they are depositors or policy holders, is vastly in excess of this total.

An analysis of the Company's stockholders shows the number of holders of lots of from one to five shares each to be 10,452. By a coincidence, this corresponds almost exactly with the 10,471 shareholders owning from six to ten shares of stock each. The combined holders of these small blocks aggregate 20,923, or approximately three-fifths of all of the Company's stockholders. Further details are given below:

DISTRIBUTION OF STOCK ACCORDING TO SIZE OF HOLDINGS

Stockholders Owning or Subscribing for	PREFERRED	COMMON	TOTAL	% OF ALL HOLDERS
1 - 5 Shares	6,525	3,927	10,452	29.4%
6 - 10 "	4,704	5,767	10,471	29.5%
11 - 100 "	9,053	4,218	13,271	37.4%
101 - 1000 "	565	628	1,193	3.5%
over 1000 "	17	55	72	.2%
Total	20,864	14,595	*35,459	100.0%

The actual and relative distribution of ownership of the Company between men and women stockholders is shown in the following summary. It is interesting to note that there are 13,888 of the latter owning some $28,134,100 par value of stock. A great majority of the 4,284 "joint tenants" are husband and wife, so that the number of women who are partners in this enterprise in fact aggregates approximately 18,000.

DISTRIBUTION OF STOCK AS BETWEEN MEN AND WOMEN STOCKHOLDERS

	PREFERRED	COMMON	TOTAL	% OF ALL HOLDERS
Men	9,263	7,453	16,716	47.2%
Women	8,591	5,297	13,888	39.2%
Joint Tenants	2,771	1,513	4,284	11.9%
Associations, Insurance Companies, etc.	239	332	571	1.7%
Total	20,864	14,595	*35,459	100.0%

Slightly in excess of four-fifths of the Company's stockholders are residents of California. The following tabulation gives details of the distribution of preferred and common stocks as between Californians and those outside the State:

GEOGRAPHICAL DISTRIBUTION OF STOCK OWNERSHIP

In California:	PREFERRED	COMMON	TOTAL	% OF ALL HOLDERS
*Employees	1,345	344	1,689	4.8%
Customers and Others	17,335	9,455	26,790	75.5%
Total California	18,680	9,799	28,479	80.3%
Outside California	2,184	4,796	6,980	19.7%
Total	20,864	14,595	*35,459	100.0%

*Excluding 2,372 employees purchasing stock on the installment plan.

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERSTS OF THE PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
445 Sutter Street, San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVI OCTOBER, 1925 NO. 6

The current issue of Pacific Service Magazine is devoted mainly to the exploitation of electricity as an invaluable aid to modern agricultural development.

That California occupies first place among the States of the Union in rural electrification is generally conceded. The leading lights of the electrical industry in this country who attended the great convention of the National Electrical Association in San Francisco last June one and all paid tribute to our Golden State for her pioneer work in the cause of progress and development. Mr. Louis J. Taber, Master of the National Grange, a great national organization of practical farmers, addressed the electrical men of California in these terms:

"Your leadership in this regard has been of value to all; your genius in applying electrification to agricultural affairs has been helpful; you have been blazing a trail that others will follow."

It is with no small pride that we remind our readers that in this pioneer work "Pacific Service," through its predecessors in interest, played a prominent part. As a matter of fact it was in this section of north-central California that the idea of electricity as an efficient as well as an economical farm servant first took hold. By gradual progress the idea has been developed into practical result and a new era in agriculture has been ushered in through its agency.

The California Committee on the Relation of Electricity to Agriculture, which is headed by a college professor and whose personnel includes scientists, practical farmers, electrical appliance manufacturers and representatives of electric service corporations, collected a number of interesting facts concerning the use of electric power on the farm in our Golden State. The following figures were given:

Total number of farms in California, 117,670; improved land in farms, acres, 11,878,000; average size of farms, acres, 100; number of farms irrigated 67,931; total area of irrigated farm land acres 4,219,040; per cent irrigated, 57.3; total area of irrigated by pumped water, 868,060; number of pumping plants; 21,561; total horsepower used in pumping plants, 386,200; total number of rural electric power consumers (1923) on farms, 26,915; total number of electric motors (1923) on farms, 30,000; total number of rural electric lighting, cooking and other domestic service consumers (1923), 93,156; total electric energy consumed on the farms in California (1923) in kilowatt hours, 421,646,000; in horsepower hours, 554,000,000.

Since that census was taken the cause of rural electrification has advanced. It has been estimated that today the number of farms in California stands at 145,000 and that this increase is partly due to a reduction in the average size of the farm. Electrical irrigation has increased the production per acre and, as a natural consequence, reduced the size of the holding necessary to insure a living return.

The progress of our company's agricultural "load" through the years is given elsewhere in this issue. Nothing, perhaps, can tell the story quite so vividly.

IN THE INTEREST OF TRUTH

Two misstatements have been repeatedly made in relation to the arrangement under which the Pacific Gas and Electric Company is distributing Hetch Hetchy electric power for the city of San Francisco. One is that the company gets 24 per cent of the power for nothing. The other is that the company is making a tremendous profit, because of the difference between the amount collected by the company as the city's agent and the sum paid to the city. It is even asserted that this difference is all profit.

As for the first misstatement: The Pacific Gas and Electric Company gets no

Hetch Hetchy power for nothing. It is an elemental fact that electricity cannot be handled without some loss of energy; one might as well expect the iceman to deliver to consumers as much ice as he started out with. That 24 per cent represents energy lost in transmission and distribution between Newark substation and the meters of San Francisco consumers. This figure was agreed upon by the contracting parties because the company's reports for 1924, filed in obedience to law with the State Railroad Commission, show that Pacific Gas and Electric Company actually put 24 per cent more electrical current on its San Francisco wires than it sold to consumers or used for its own purposes. Further, that figure of 24 per cent is less than the loss shown in many other operations in various parts of the country.

As for the second misstatement: The temporary contract between the city of San Francisco and the company provides that 26.935 per cent of the moneys received in the distribution of power shall go to the city and 73.065 per cent to the Pacific Gas and Electric Company, such return to be based on a rate of 2.383 cents per kilowatt hour, which was the company's average return in San Francisco for all kilowatt hours of energy sold in 1924. That same year the company's net return, on the rates fixed by the Railroad Commission for the various communities of Northern and Central California, was 7 per cent on its actual investment in properties used in the creation, transmission or distribution of electricity. The mere fact that it is now distributing Hetch Hetchy power in place of an equal amount of its own power cannot transform a 7 per cent return into an enormous profit.

On the basis of agreement set forth in the contract for temporary distribution of Hetch Hetchy power the return to the city of San Francisco for the month of September was $182,426.97, which was considerably more than one-twelfth of the $2,000,000 a year estimate that formed the basis of the agency contract. The total amount collected at the average rate of 2.383 cents per kilowatt hour was $677,285.96, of which the company, under the terms of the agreement, retained $494,858.99. Out of that amount had to come many large items of expense. Hetch Hetchy power had first to be brought from Newark to San Francisco; then the voltage was transformed from 110,000 to 11,000. Next, the power was distributed to ten substations throughout the city. In those substations the voltage was further reduced and much of the power converted to direct current before it was finally delivered to consumers at 150,000 separate points. The company also had to read the meters, prepare and send out and collect the bills, furnish all operating labor and supply and maintain all equipment, including that of street lights.

Then, there was the large expense of providing additional plant capacity in order to carry the peak of the load in San Francisco and maintain a steam standby reserve. In 1924 San Francisco's peak demand, which means the largest amount of electrical energy that had to be provided at a particular time, was 160,000 horsepower, which, after allowing for transmission loss, is just about double the capacity of San Francisco's power plant on Moccasin Creek. So, in September there were times when Hetch Hetchy power was only half enough to supply San Francisco's needs and the company had to make up the difference lest homes and stores go dark and street cars stop and factories lie idle.

Again, what if something should go wrong at the Moccasin Creek plant, or an insulator fail on the transmission line? This company has never relied entirely on transmission power for serving San Francisco, but has always maintained an adequate steam standby reserve with steam up and turbines actually in operation in instant readiness to take up the load. This was done constantly, day and night, all through September, even at times when hydroelectric power was actually going to waste. This service is expensive, and this expense is part of the cost of marketing Hetch Hetchy power.

Another big expense had to be met. Provision was made to meet the demands of the various tax collectors, Federal, State and local, whose aggregate toll comes close to ten cents on every dollar collected by the company. The State alone takes 7½ cents, and as its impost is based on gross receipts the company will have to pay out $50,796.45 of its September Hetch Hetchy collections in taxes.

Such are the facts. The truth is plain enough to convince anyone open to reason that there is no free power and no great profit. Figures in possession of the State Railroad Commission prove that neither assertion could possibly be true, and their repetition is doubtless inspired by the hope that possibly some of the people will be fooled.

The true history of this Hetch Hetchy project was given to the public quite recently by the *San Francisco Chronicle* in a series of editorial articles in which the actual facts were set down without fear or favor. At the conclusion of the series the *Chronicle,* in an editorial bearing the heading "Cold Facts Refute Political Nonsense About Hetch Hetchy," had this to say:

"Hetch Hetchy is, first, last and all the time, a water supply project. Hydroelectric development, pow r distribution and partisan politics are all side issues that too often confuse the mind of the public.

"With no motive but to recall to the public the primary and overwhelmingly important purpose of Hetch Hetchy, *The Chronicle* has just presented a short series of editorial articles telling the real story of the project since its inception twenty-one years ago.

"Conscientious care was taken to avoid expression of ex-parte opinion. If the reader has been influenced, it is only by the cold logic of the facts. Now that the series has ended, a statement of conclusion is justified in answer to the ridiculous political shout to 'Return Hetch Hetchy to the people' and the persistent accusation that there was a 'plot' to complete the power plant before the city had a distributing system, so that the power could be 'sold out' to a corporation.

"The facts are that the Raker Act passed by Congress in 1913 forced the city to build hydro-electric plants in connection with the Hetch Hetchy water supply project. Thus the city, seeking an ample water supply, suddenly found itself thrust into the business of manufacturing electricity. Instead of a $45,000,000 investment, the city had to take on the burden of a $78,000,000 investment to complete the water supply, with the prospect of having to pay $38,000,000 for a water distributing system and $45,000,000 for an electricity distributing system.

"The charter provides a limit to the amount of bonds the city may issue. The city had not the money to build a power plant and buy or build an electricity distributing system. But the Raker Act insisted upon development of hydro-electric energy within a specified time. It did not specify a time by which it must be distributed over a municipal distributing plant.

"If the city bought or built the distributing system first it would have the system but nothing to distribute over it.

"If the city built the power plant first—and it had to develop power within a specified time—it would at least have something to distribute, even though a way had to be found to do it.

"The distributing system would be a dead loss until the power plant was built. The power plant might produce some revenue. And the city HAD to produce power to comply with the Raker Act, but did not have money enough to build the power plant and acquire a distributing system at the same time.

"In common sense, which should it do first—build the power plant or acquire a distributing system?

"The answer to this must be obvious. And that is the answer found by the officials now being accused of 'selling out' the city. Their justification is the $182,000 monthly income, coming in in real money, from the power produced at Moccasin Creek.

"The politicians who are raising the cry of 'Return Hetch Hetchy to the people' know that they are talking nonsense, because the people have Hetch Hetchy and intend to keep it. The nonsense comes from the same source that tried to stop the temporary contract by a cry that it would 'forfeit Hetch Hetchy.' Don't forget that. And just observe that that shout has been stilled. We do not hear any more about 'forfeiting Hetch Hetchy.'

"That issue was nonsense when it was raised, and it was raised by people who knew it was nonsense. Now they are off on another track—that is all. And it is as great nonsense as the former cry. It was to provide the public with facts to refute nonsense that *The Chronicle* published the real story of Hetch Hetchy."

PACIFIC GAS & ELECTRIC COMPANY

A California Corporation

Managed by Californians — Operated by Californians

"PACIFIC SERVICE" REPRESENTS (AS OF JULY 31, 1925)

12,038 employed in all departments.

$266,000,000 capital invested in gas, electricity, railroads, steam, water and telephone plants.

59,000 square miles of territory in which it operates—an area greater than that of England and Wales.

35,459 stockholders.

38 counties of the state in which it transacts business.

783,044 consumers served with gas, electricity, water and steam.

2,158,000 people in 38 counties, which is over 50 per cent of the State population.

291 cities and towns in which it supplies service directly and through other companies.

$19,393,420 annual wages paid employes, year ending July 31, 1925.

$3,151,497 taxes, state and county, year ending July 31, 1925.

$1,070,724 taxes, Federal Government, year ending July 31, 1925.

534,818 horsepower developed in 28 electric water-power plants.

190,349 horsepower developed in 4 electric steam plants.

725,167 total horsepower developed in 32 plants.

1,327,438,875 kw. hrs. sold, year ending July 31, 1925. This is equivalent to the effort of 4,425,000 men.

15,903,525,400 cubic feet of gas sold, year ending July 31, 1925.

16 gas plants.

12,502 miles of transmission and distribution lines. Greater than the distance between San Francisco and Calabar, West Africa.

3,992 miles of mains used in distributing gas. Greater than the distance between San Francisco and Bogota, Colombia, South America.

1,100 miles of mains and ditches used in distributing water.

1,100 miles of track of street railway supplied with electric power.

70,340,568,100 gallons of water storage capacity in 109 lakes and reservoirs. This amount of water would supply the City of San Francisco at the present rate of consumption for nearly 5 years.

117,562 acres of land owned in California.

264 parcels of property owned in cities and towns.

5,591,403 barrels of California Oil used, year ending July 31, 1925.

190,458 horsepower in agricultural motors depending on "Pacific Service."

580,836 horsepower in mining, electric railways, manufacturing and other motors depending on "Pacific Service."

38,648 street lamps, gas and electric, lighted by "Pacific Service."

7,507,809 incandescent lamps nightly lighted.

1,441,168 horsepower connected to system.

PACIFIC GAS AND ELECTRIC COMPANY

General Office: 245 Market Street

San Francisco

Branches in all principal cities and towns of 38 counties of North Central California.



Three of the Premier Public Utility Securities of the United States

Every One of the

Eighty Thousand Investors

who own

Pacific Gas and Electric Company Bonds and Stocks

receives

Interest and/or Dividends Regularly

Pacific Gas and Electric Company

FIRST AND REFUNDING MORTGAGE BONDS

FIRST PREFERRED CUMULATIVE STOCK (6%)

COMMON STOCK (8%)

are held in high regard by the investing public because

They are securities of one of the largest, strongest and most progressive of the nation's public service companies;

The property securing these issues is worth millions of dollars more than the entire outstanding capitalization;

The Company's business is essential in character, and is increasing steadily year by year;

These securities are always readily marketable. They are listed on Stock Exchanges in San Francisco and other financial centers.

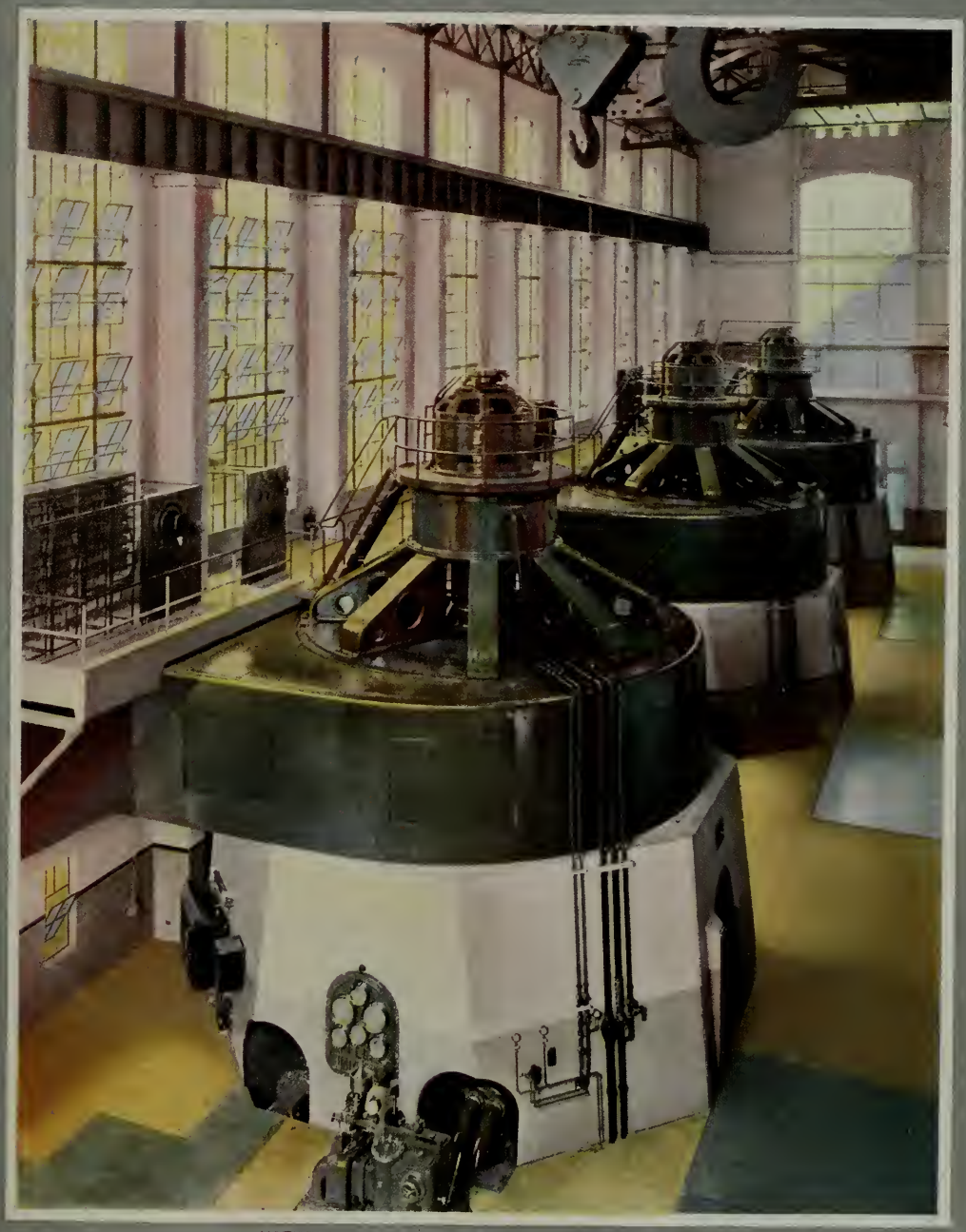
Pacific Gas and Electric Company

STOCK SALES DEPARTMENT

245 MARKET STREET, SAN FRANCISCO, CALIF.

PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO



INTERIOR OF PIT RIVER POWER HOUSE No. 3

Vol 16 — JANUARY 1926 — No 7

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER	A. B. C. DOHRMANN	FRANK A. LEACH, JR.
F. B. ANDERSON	JOHN S. DRUM	NORMAN B. LIVERMORE
CHAS. L. BARRETT	F. T. ELSEY	JOHN D. McKEE
W. E. CREED	D. H. FOOTE	JOHN A. McCANDLESS
W. H. CROCKER	A. F. HOCKENBEAMER	C. O. G. MILLER

OFFICERS

W. E. CREED . . . . . *President*
FRANK A. LEACH, JR. . . . . *First Vice-President and General Manager*
A. F. HOCKENBEAMER . . . . . *Second Vice-President and Treasurer*
D. H. FOOTE . . . . . *Third Vice-President and Secretary*
CHAS. L. BARRETT . . . . . *Assistant Secretary*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, JR., Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney . . . . . LAW DEPARTMENT
C. P. CUTTEN, Attorney . . . . . RATE DEPARTMENT
R. J. CANTRELL, Manager . . . . . PROPERTY AND TAX DEPARTMENT
E. W. HODGES, General Auditor . . . ACCOUNTING DEPARTMENT
H. T. TERRY . . . . . CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager . . . . . CREDIT AND STOCK SALES DEPARTMENTS
JOHN H. HUNT, Purchasing Agent . . PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent . . . SUPPLY DEPARTMENT
E. G. McCANN, Manager . . . . PERSONNEL DEPARTMENT

ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT

O. W. PETERSON . . . . . Engineer of General Construction
E. H. STEELE . . . . . Engineer of Line Construction
F. R. GEORGE . . . . . Engineer of Operation
GEO. H. BRAGG . . . . . Engineer of Maintenance

DEPARTMENT OF ENGINEERING

J. P. JOLLYMAN . . . . . Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER . . . . . Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE . . . . . Chief of Division of Civil Engineering
F. M. HARRIS . . . . . Chief of Bureau of Specifications and Estimates
O. A. KNOPP . . . . . Chief of Bureau of Tests and Inspection

DEPARTMENT OF EXECUTIVE ENGINEER

F. C. PIATT . . . . . Valuation Engineer of Electric Properties
J. T. RYAN . . . . . Valuation Engineer of Gas, Water and Railway Properties
B. B. BECKETT . . . . . Rate Engineer
S. B. SHAW . . . . . Automotive Engineer
W. G. JACK . . . . . Manager Land Department

GAS CONSTRUCTION AND OPERATION DEPARTMENT

FRANK WILLS . . . . . Engineer of Production
R. S. FULLER . . . . . Engineer of Distribution
HARRY J. SMITH . . . . . Engineer of Construction

PUBLIC RELATIONS AND SALES DEPARTMENT

R. W. ROBINSON . . . . . Assistant to Vice-President in Charge of Public Relations and Sales
DON C. RAY . . . . . Manager Bureau of Public Relations
N. R. SUTHERLAND . . . . . Manager Commercial Department
H. M. CRAWFORD . . . . . Sales Manager
R. T. STEPHENS . . . . . Manager Electric Sales
FORREST U. NAYLOR . . . . . Manager Gas Sales
J. CHARLES JORDAN . . . . . Manager Publicity Department

W. B. BOSLEY
General Counsel

JOHN P. COGHLAN
Assistant to the President

F. S. MYRTLE
Editor-in-Chief Pacific Service Magazine

DIVISIONS AND MANAGERS

DIVISION MANAGERS		DISTRICT MANAGERS		HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION			Marysville
		J. V. KYLE	Colusa District	Colusa
I. B. ADAMS	DE SABLA DIVISION			Chico
H. M. COOPER	DRUM DIVISION			Auburn
		L. H. HARTSOCK	Nevada District	Nevada City
L. H. NEWBERT	EAST BAY DIVISION			Oakland
		J. H. PAPE	Berkeley District	Berkeley
H. C. ROSS	FRESNO DIVISION			Fresno
H. G. RIDGWAY	NORTH BAY DIVISION			San Rafael
		L. J. PETERSON	Petaluma District	Petaluma
		C. D. CLARK	Napa District	Napa
		C. D. CLARK	Vallejo District	Vallejo
		M. G. HALL	Santa Rosa District	Santa Rosa
E. W. FLORENCE	SACRAMENTO DIVISION			Sacramento
		C. E. SEDGWICK	Solano District	Dixon
		J. W. COONS	Yolo District	Woodland
HENRY BOSTWICK	SAN FRANCISCO DIVISION			San Francisco
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION			Modesto
		W. E. ESKEW	Electra District	Jackson
		C. R. GILL	Modesto District	Modesto
		J. H. FAGG	Stockton District	Stockton
		CHAS. H. NOACK	Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION			San Jose
		W. T. KELLOGG	Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION			Redding
H. B. HERYFORD	WEST SIDE DIVISION			Red Bluff
		STEPHEN GOIN	Willows District	Willows
		CHAS. HUGHES	Red Bluff District	Red Bluff

Pacific Service Magazine

Volume XVI Number 7

Contents for January, 1926

VIEW OF THE RIVER FROM PIT NO. THREE - - - *Frontispiece*

STARTING WORK ON PIT NO. FOUR - - - *F. S. Myrtle* 203

NEW 220,000 VOLT LINE TO ANTIOCH, WITH LONG SPAN RIVER CROSSINGS - - - *L. J. Corbett* 206

A BRAVE EXPERIMENT IN WIRE-TAPPING - - - - - 210

"PACIFIC SERVICE" PLAYS AN IMPORTANT PART IN THE MARBLE QUARRYING INDUSTRY - *Ward C. Schafer* 212

PENINSULA DEVELOPMENT AIDED BY "PACIFIC SERVICE"---DEVONSHIRE HILLS - - - *F. A. Peck* 216

GAS, THE INDUSTRIAL SUPER-FUEL - - - *J. H. Gumz* 217

THE LATE R. R. COLGATE, PIONEER OF "PACIFIC SERVICE" - - - - - - - - - - 222

IN MEMORIAM---CHARLES W. McKILLIP - - - - - 223

THE FINANCIAL SIDE OF "PACIFIC SERVICE" - - *A. F. H.* 224

WIDENING SAVINGS BANK INVESTMENT FIELD - *E. J. Beckett* 226

EDITORIAL - - - - - - - - - - - - - 230



On Pit River. Looking down stream from Pit Three power-house. The diversion dam at Pit Four development will back the waters of the river to this point

PACIFIC SERVICE MAGAZINE

VOLUME XVI JANUARY, 1926 NUMBER 7

Starting Work on Pit No. Four

By FREDERICK S. MYRTLE

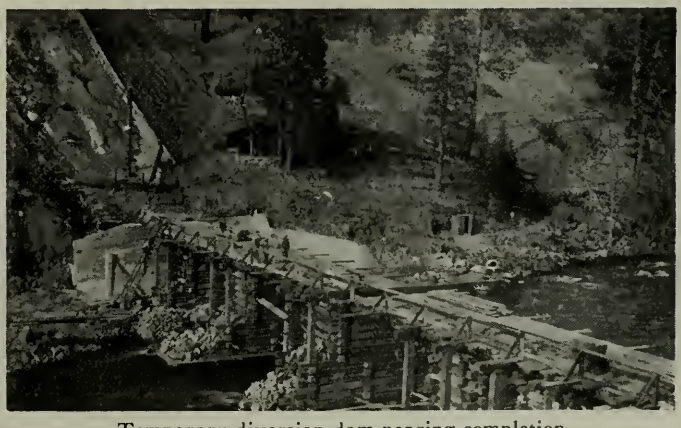
There is, apparently, no period of rest in sight for our company's Departments of Engineering and Electrical Construction. With regard to the Pit river development now in progress, the completion of one power plant in the chain affords but a brief breathing spell for our engineering forces before word is sent out to commence work on the next in order.

Pit No. Three was formally placed in service August 1, 1925, and ever since that date has been industriously contributing its hourly quota of electrical energy to the "Pacific Service" pool. And now we are hard at work on Pit No. Four.

The outstanding engineering features of this development are similar to those of its immediate predecessor. They include a diversion dam, by which the waters of the stream will be impounded into a reservoir reaching back to the development nearest up-stream and thus forming an open conduit for the water released therefrom, to the entrance of a tunnel by which water diverted at the dam will be conveyed in a bee-line across country to a point from which it will be dropped to turn the wheels of a powerhouse on the river bank below.

A site for the dam has been marked at a point about two miles down stream from Pit No. Three powerhouse. At this point bedrock appears practically at the ground surface on the right bank of the river, but from this bank it drops below the stream reaching a depth of about fifty feet at the left edge of the river channel. Beyond the left bank its depth increases. The design for the dam, therefore, calls for a composite structure, with a heavy overpour gravity section from the left edge of the channel to the right abutment and a lighter non-overpour structure at the left side. A heavy concrete division wall 30 feet thick and 200 feet in length resting on bedrock up and down stream along the left bank of the river will divide the two halves of the dam. Between this wall and the right abutment will be the overpour section of the dam, with heavy steel roller type gates surmounting its crest. From the wall back for a distance of 200 feet on the flatter left hillside will be a non-overpour concrete barrier. The dam will rise sixty feet above the surface of the stream and will have a total width of 430 feet, the overpour section being 150 feet in width. There will be a large amount of difficult excavation for the foundation and about 50,000 cubic yards of concrete will be required for the construction of this dam. The reservoir created by the raising of the waters will be of 2,000 acre feet capacity and will serve as an afterbay for Pit No. Three as well as a forebay for Pit No. Four.

As at Pit No. Three, in order to enable the construction of the permanent dam foundation on dry bedrock there is in process of erection a temporary dam by which the river will be diverted into a timber flume which will carry the water past the per-



Temporary diversion dam nearing completion. First section of flume in place.

manent dam site to a point below where it will be returned to the stream. This temporary dam is of rock-crib construction. The flume leading from this will be 11 feet deep and 24 feet wide, sufficient to carry a volume of 3500 second feet of water, more than the usual flow of the river between May 1st and December 1st. The temporary dam is located 500 feet up-stream from the permanent dam site. The temporary diversion flume will be about 1600 feet in length, its lower end being about 900 feet below the toe of the permanent dam.



Upstream face of temporary diversion dam.

The entrance to the tunnel will be located 100 feet up-stream from the permanent dam. It will be 23,782 feet in length, 19 feet in diameter, of 3000 second feet capacity, and can be driven from four headings. The intake at the head of the tunnel will be of the same general type as that of Pit No. Three.

At a point near the power-house end of the tunnel a short branch will connect with a concrete surge chamber cut into the side of the hill. The purpose of this, as at Pit No. Three, is to take up the surges in flow occasioned by fluctuations in the quantity of water being required by the power-house turbines. A spillway and waste pipe will carry waste water from the surge chamber to the tail-race.

From the lower portal of the tunnel three penstocks 129 inches in diameter will branch out through a manifold section. At the head of each pipe a butterfly valve will be inserted for the control of the flow. The penstocks will be about 1100 feet in length and will utilize a head of 377 feet to deliver water to the power-house.

The equipment at Pit No. Four power-house will be of somewhat greater capacity than at Pit No. Three. It will consist of three 40,000 horsepower turbines connected to 33,333 k.v.a. generators. The transformer installation will consist of three banks of three 11,000 k.v.a. transformers, with spares for emergencies.

The power to be generated at Pit No. Four will be taken into the "Pacific Service" distributing system by means of sixteen miles of 220,000-volt double circuit transmission on steel towers, tying in to the main Pit-Vaca lines at Round Mountain. Pit No. Three and Pit No. Four will also be tied together by a single circuit tower at the same high voltage.



Looking down river at portion of temporary diversion dam. Temporary diversion flume will have its intake at right side through opening shown.

It was the business of our Department of Engineering to locate the site for the diversion dam, a work which entails exploring river bottoms for foundation and examining soil

and rock for abutment locations, to chart out the tunnel by which the water is to be taken across country, settle the location of the power-house, decide upon its equipment, work out transmission details and plan other incidentals of minor spectacular importance, but all part and parcel of the one great scheme of hydro-electric power development. These plans were prepared some months in advance of the completion of Pit No. Three. They were approved in due course and last October the official word was sent out to the Department of Electrical Construction and Operation to proceed with the work.



View of tunnel intake and right abutment of Pit No. 4 dam. Railroad runs along the hillside 100 feet above river level. Bunkers for sand and gravel and foundations for concrete plant are complete.

A construction camp capable of accommodating 200 men was built and equipped and transportation for machinery and supplies was provided by extending the Pit river railroad from Pit No. Three power-house, a distance of two miles, to the dam site, and one and one-half miles farther on to a flat on the river from which it is expected to obtain sand and rock for making concrete. The railroad passes the dam site at an elevation of 100 feet above the river bed, this elevation affording the height and space required for the assembling of the concrete plant to be used in constructing the dam. After a while the railroad will be extended six miles farther down stream to the power-house site. An aerial cable way used originally on our Lake Spaulding development spans the river between towers high above the railroad. This cable way will provide transportation for men, material and equipment, back and forth, between the main railroad grade and the river bed.

At the time of writing the following has been accomplished: The temporary diversion dam is well along toward completion, only a few cribs in the river channel and the plank facing, which will be put on to divert the river into the flume, remaining to be placed. The bench along the right edge of the river on which the diversion flume will rest has been entirely excavated, and likewise the greater portion of the foundations in the right abutment of the permanent dam. The concrete mixing plant, including cement storage house, sand and gravel bunkers, is in place on the hillside. The top heading of the tunnel has been excavated for a distance of 300 feet. A power shovel will soon start excavating on the left bank of the river removing as much material as possible before the diversion of the river takes place.



This power shovel has excavated a cut 1000 feet in length, in which the flume for diversion of the river from its channel will be constructed.

At this time it is expected that all danger of run-off from snows and unusual rains will be over by May 1st, so that the diversion of the river into the flume may take place at that time. It is expected that all excavation work and pouring of concrete into the river bed will be completed before the end of the present year.

New 220,000 Volt Line To Antioch, With Long-span River Crossings

By L. J. CORBETT, Department of Engineering.

As many will recall, it was a gala day for our Pacific Service organization when, with appropriate ceremonies, the final connections were made and power from the Pit River development was delivered to the transmission network at Vaca-Dixon Substation, September 30, 1922.

This block of 100,000 horsepower has aided materially in supplying the demands of consumers in the bay district since that time, particularly during the "dry year" of 1924, when not only were our own consumers furnished all their power needs but substantial amounts of energy were delivered to less fortunate public service companies to the south to lessen the curtailment necessary on their systems. But, in a community like California, the demand for power grows at a rapid rate. Already a new plant on the Pit River has been added to the system, and to take care of the additional power to be delivered to the bay district the transmission lines must again be increased in capacity.

For some years there has existed a "tie line" between the Bay lines at South Tower (Carquinez Straits) and the Standard line at Herdlyn, operating at 60,000 volts and feeding a number of important loads at Mountain Copper, Avon, Nichols, Pittsburg, Antioch and Middle River. When the 110,000 volt tower line from Vaca-Dixon to Oakland was constructed in conjunction with the first Pit power delivery the existing 60,000-volt crossing at Carquinez was reinsulated for 110,000 volts and a section of the Bay lines was abandoned. However, transformers were installed at South Tower which not only serve the local loads in the vicinity at 11,000 volts but, also, supply the line to Richmond and this tie line to Herdlyn at 60,000 volts.

The industrial load along the tie line has been growing and although it is fed from both ends it would not be long before the industries in this section would suffer from insufficient power facilities if measures were not taken to serve them more adequately. As it had been planned eventually to extend the 220,000 volt line from Vaca-Dixon to Newark or to a station near Newark but away from the fog belt, it was thought best to construct the first link of this line from Vaca-Dixon to a temporary terminal near Antioch and build there a substation where the transformation to 60,000 volts might be accomplished and the power fed in at the middle of the tie line, close to the large industrial loads.

At first, the line from Vaca-Dixon is to be operated at 110,000 volts, but as it is expected that it will soon need to be raised to 220,000 volts, the line is being built suitable for operation at the higher voltage so that no delays will occur from that feature when the change is made.

The general type of construction is similar to that on the valley end of the Pit line. The towers are built for two independent circuits, the three wires of each circuit being suspended fifteen feet apart vertically, the circuits being held 24 feet apart on the opposite sides. For the present, only one circuit will be strung except at the crossing; the second can be readily strung at a later date when the demands still further increase. Because of the unusual nature of the crossing and the expensive rigging which will be necessary there, both circuits will be strung on that portion in the original construction.

The conductors, except at the crossing, are similar to those on the Pit transmission, —large copper cables nearly one inch in diameter. These will be hung from the tower arms on strings of insulators seven feet long.

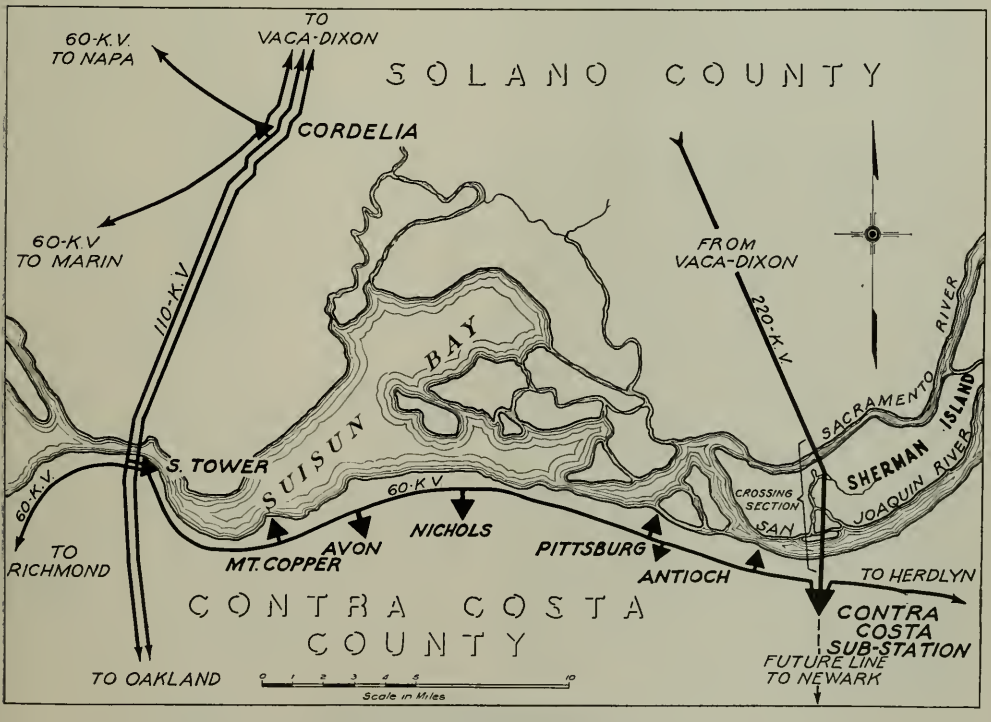
The necessary increases in the facilities at Vaca-Dixon have been completed and construction is well along on the new Contra Costa substation near Antioch. In fact, it will be in operation by about March 1. The transmission line is practically complete with the exception of the crossing portion.

The new line starts south from Vaca-Dixon over flat agricultural ground, then

swings south-easterly over the hilly land north of the upper bay and crosses Sherman Island and the Sacramento and San Joaquin Rivers some five miles above their confluence. The total length of line is a little over 29 miles. The portion involved in the crossing is slightly less than five miles in length from the anchor tower on the north bank of the Sacramento River to that on the south bank of the San Joaquin.

At the Carquinez Crossing, as readers of PACIFIC SERVICE MAGAZINE may remember, the conductors are steel cables attached through steel work and insulators in compression to concrete anchors embedded in the ground, and on the towers they rest upon saddles supported by pillar insulators, also in compression. At the present time the conductors on our standard tower lines are held by suspension insulators. As many units as are required for insulation are linked together to make the complete string, with suitable hook or clevis at one end and clamp to hold the conductor at the other. At the time the Carquinez crossing was designed in 1901 the suspension insulator had not yet been developed. Since its development some long spans have been constructed in which the cables have been held entirely by multiple strings of suspension insulators between strong towers at each end of the span. The proposed crossing will be, in a way, a combination of certain features of both methods, though it will utilize the suspension type of insulators only.

The long spans over the separate rivers will have to be supported on very high towers, and to make those towers strong enough to hold the entire pull in the cables would make them extremely expensive. On the other hand, if they are to hold the weight of the cables only, the tension being held at the ends, the high towers can be comparatively light. The plan adopted for the new crosssing is to have the tension in the conductors held by low but strong anchor towers situated well back from the river banks, and to support only the weight of the conductors on the high towers at the long spans, together with any pressure due to wind. The maximum pull anticipated in each conductor is 20,500 pounds. This may occur on a cold day with considerable



Map showing relation of new line to adjoining portions of the "Pacific Service" transmission system and the location of the crossing

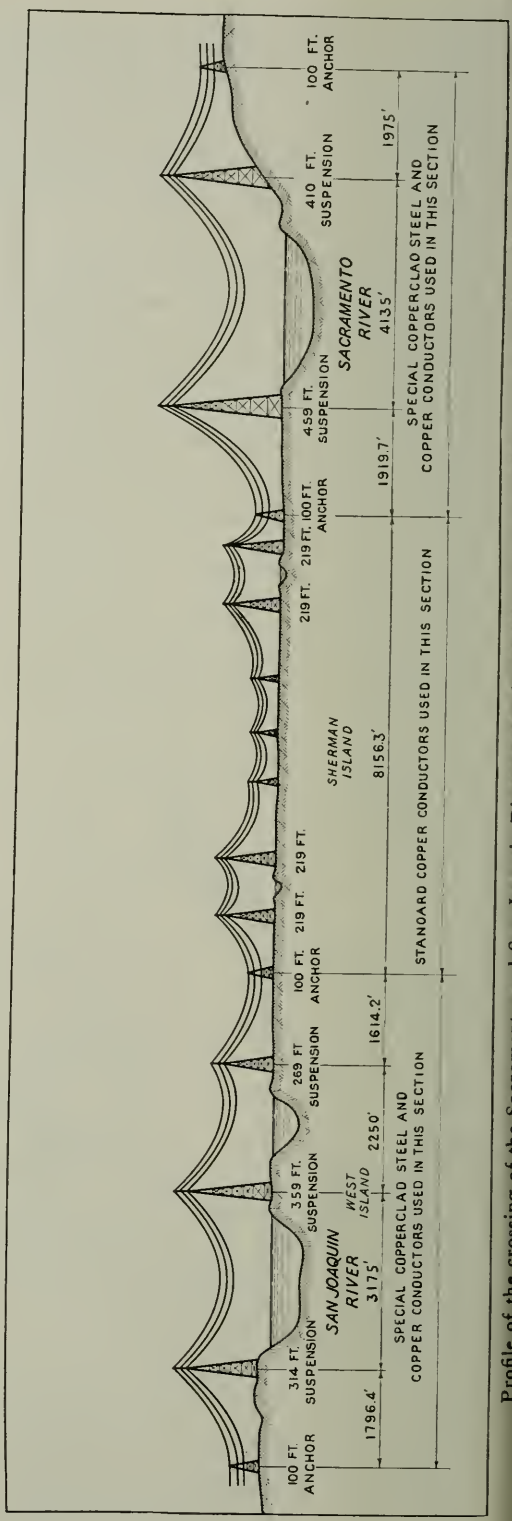
wind. On a warm, quiet day in midsummer, the pull may be reduced to about 18,000 pounds. The pull will be held at the anchor towers by a special quadruple string of extra strong suspension insulators. Four strings of insulators will be combined as a single mechanism, and the load equalized so that each separate string takes its share.

The weight of cable to be held on the high suspension towers may reach a maximum of some 8600 pounds on the longest spans, which, with a stiff wind blowing, may produce a pull of 9,000 pounds at each support. The conductor will rest on a saddle suspended by a double string of extra strong insulators, these strings dividing the load equally between them.

On the standard portion of not only the Pit line from Cottonwood to Vaca-Dixon but, also, the portion of the new line from Vaca-Dixon to the Sacramento River, the spacing between conductors of each circuit is 15 feet, and the circuits are 24 feet apart. On the high crossing the vertical spacing between conductors is to be 25 feet, and the circuits will be 38 feet apart. Also, on the crossing towers the insulator strings will be 50 per cent longer than on the standard sections and the clearance from tower members 50 per cent greater, as additional precautions against the occurrence of trouble on the crossings themselves.

The lower conductors will be supported 50 feet above the tops of foundations on the anchor towers, which, to give the required 25 feet clearance between wires will be a total of 100 feet in height. The five suspension towers, in order to hold the lower cables at the required distance above the water and allow for the conductor clearances, will have total heights of 269, 314, 359, 410 and 459 feet above their foundations. It is believed that the highest of these will set a new record for height of towers used in a transmission line. However, this is only incidental. The record voltage of 220,000 volts was adopted on the Pit transmission line, not to set a record but because it was shown to be the most economical voltage to use. So, these tower heights were arrived at only after careful study of the topography or "lay of the land" at the crossing and of the types of cables which could be used for conductors.

The conductors were extremely important in this study. If copper cables should



Profile of the crossing of the Sacramento and San Joaquin Rivers east of Antioch

be used, the tension or pull on the conductors could not be so great; the sag would be greater and the towers would be considerably higher than as now designed. Cables of steel alone could be pulled much tighter and thus shorter towers could be used; but steel has a high resistance to the flow of electric current, and to carry the current expected at the crossing the cables would have to be very large and heavy. This in turn would call for heavier towers, larger fittings and stronger insulating parts. The cable decided upon is a "mixed" strand of 19 wires of four different sizes. Thirteen wires of three different diameters are of copper clad steel to furnish the strength required and six large wires are of copper, alternating with copper clad steel wires in the outer layer to add suitable conductivity. The wires are twisted together in a very compact strand 0.95 inch in diameter.

The longest span involved is that over the Sacramento River, a distance of 4135 feet. (The Carquinez span is 4427 feet). However, the total distance between anchor towers is 8835 feet on the section over the San Joaquin River, the cable being draped on three intermediate suspension towers, and the total distance is 8030 feet in the section over the Sacramento River, where two intermediate suspension towers will support the long span. The four anchor towers are alike, and shaped somewhat like the "snow" type of transmission tower familiar to many of our readers, especially in the mountain districts. Two A-shaped sides are thoroughly braced and cross-braced to each other and the attachments for the cables will be, respectively, at the top, 25 feet and 50 feet below the top on each A-shaped side.

It takes considerable strength to hold six cables on each of which is a pull of over 20,000 pounds. Therefore, these anchor towers are made of heavy structural steel and weigh about 31 tons each. There are concrete footings under each leg, all together containing 140 cubic yards at each tower. On the hard ground north of the Sacramento and south of the San Joaquin these are set in the solid earth. On the marshy island portion 32 piles are used at each tower, driven to sufficiently dense material to support the load. Some of these are driven at an angle from the vertical in order to brace more completely against the resultant pull.

The high suspension towers are all of the same design at the upper portions. The lower sections are designed to carry down the proper batter and to be added as required to give the necessary height. These towers also must be strong to stand the weight of the conductor, the pressure of the wind on both tower and conductors and to stand the strains which may come upon them during construction. The highest one will extend 459 feet above the foundations and will contain 404,500 pounds of structural steel. The suspension towers also have concrete foundations at the four corners, totalling 270 cubic yards per tower. As with the anchor towers, the foundations at the north and south river banks are set in solid earth, but those in the island portions are mounted on piles driven vertically. There are from 55 to 75 piles at each of these towers.

The two crossing sections, including anchor and suspension towers, require a total of about 1,800,000 pounds of structural steel and over 1800 cubic yards of concrete. The foundations have all been completed and the anchor towers erected by "Pacific Service" men. The high towers are being erected by the steel contractor. Between these crossing sections large copper conductors as on the Pit River transmission line will be used, and also towers which were developed for that line. Three of these are standard towers and those for the two slough crossings are special towers designed for certain crossings on the Pit line but with leg extensions added. All the foundations of these towers use piles.

When the line is completed, it will afford still better service to the growing industries in the upper bay region. It will also be a link in the 220,000 volt "bus" which has been the vision of California engineers for some time, to extend eventually from the north to the south sections of the state. The crossing will be, like the Carquinez span, an engineering achievement of a high order,—a big piece of work constructed along sound engineering and economic lines.

A Brave Experiment in Wire-Tapping

Mr. A. B. Humphrey, Ranching Near Folsom, Claims the First Installation Of An Electric Motor for Agricultural Purposes

In the October number of PACIFIC SERVICE MAGAZINE appeared a review by the editor of the beginning and progress of rural electrification in our "Pacific Service" territory. In this Mr. John Martin was quoted as expressing belief that he put in one of the first, if not the first, installation of an electric motor for agricultural purposes.

Mr. Martin's claim to pioneership in this respect has been challenged. Now comes Mr. A. B. Humphrey, a sturdy rancher at present residing at Escalon, in the San Joaquin valley, with the positive declaration that he and an associate were the first people in the world to make practical use of hydro-electric energy for agricultural purposes by tapping high-tension transmission wires at a point between the generating and receiving stations.

This, Mr. Humphrey states, took place in 1898. Mr. Humphrey at the time was fruit farming near Mayhews, a station on the railroad between Sacramento and Placerville, and the 11,000-volt transmission line which was completed in 1895 to deliver power from the newly erected power plant at Folsom to the City of Sacramento passed through his property as well as that of his neighbor and partner, Mr. R. D. Stevens, commonly known as Russ Stevens, one of the oldest and best known fruit farmers in northern California and prominent in Democratic politics. To his partner Mr. Humphrey gives entire credit for the experiment that turned out so successfully and that has resulted in the widespread application of electricity to farming in California. Mr. Humphrey gives the following graphic description of this initial experiment:

"It is a matter of history that the power from Folsom first reached Sacramento on Admission Day, 1895, and that a great electric carnival was held in honor of the event. I was fruit farming then, as I am still, and my property lay on one side of the road and Russ Stevens' on the other. We were partners in a way, though our holdings were separate, and we shipped our fruit together. One day Russ said to me, 'I think it is time we did away with steam engines and gas engines and made use of electricity for power if we can possibly get it. What is the matter with using this juice that travels along these wires?' We talked it over and then Stevens took the matter up with Mr. Horatio P. Livermore, one of the builders of the Folsom power plant and the transmission line to Sacramento, which was delivering the power from Folsom to the Sacramento Electric Gas and Railroad Company to light the city, run the street railway system and furnish power from the sub-station at Sacramento to some of the larger industrial plants around the city.

"Mr. Livermore was somewhat doubtful of the experiment. He was inclined to think that it was not practicable to tap the wires between the generating and receiving stations, for the reason that the current could not be controlled. He pointed out that the most recent experiment in long-distance transmission, that between Folsom and Sacramento, was over double the distance ever before attempted and it was a grave question among engineers whether the limit had not been reached. He said, 'Voltage and amperage on a transmission line are like the pressure of water on a pipe. You can go just so far, no farther.' Mr. Livermore mentioned the installation at Nuremberg, in Germany, where a distance of thirteen miles had been traversed by the electric current, and he told me that German engineers themselves felt very dubious about the feasibility of experiments over increased distances. Concerning our proposition to tap the wires, Mr. Livermore thought he could not afford to take the chance without further investigation. 'We don't know what might happen,' he said.

"Russ Stevens was one of those men who having made up his mind to something

was not easily swerved from his purpose. He went to Sacramento and saw Mr. I. E. Gilbert, who was in charge of the sub-station at the capital city, and the result of this interview was that Gilbert wrote the General Electric Company at Schenectady. The engineers of that company refused to give any guarantee, but after some more parley they came out to San Francisco and figured on a proposition. If I remember right Mr. Schafer was the engineer from Schenectady and he had with him Mr. Iancovich from the company's office in San Francisco. They finally agreed to build three 50 kilowatt air-cooled transformers by which the voltage of electric current could be stepped down from 11,000 to 2,200, and these were to be used in connection with two 2200-volt electric motors, one of 100 horsepower and the other of 50 horsepower. In the meantime, Mr. Livermore, after further investigation had decided to permit the installation. Our agreement with him and his people was that we were to install our own equipment and pay for all the work, this work to be executed under the supervision of the power company which, however, would undertake no responsibility for the safety appliances installed.



The late Russ Stevens in his orchard

"To house our equipment we built a wooden tower twelve feet high, something like an old-fashioned water tank, that stood on legs made of wood six inches square. The house stood upon a platform that was reached by a ladder. The equipment came along in due course and the transformers were installed in the house. Then we put the switches in. The main switch that threw the current from the transmission line into the transformers was a three-knife switch, twelve inches square and fastened to the wooden wall of the building with no installation save a piece of asbestos two feet square and one quarter inch thick. With this outfit we made our first experiment in rural electrification.

"To show you how careful the manufacturing company was in building this equipment I might tell you that our 100-horsepower motor, which was six feet high and weighed 6,000 pounds, carried 134 horsepower when pumping to full capacity, which was most of the time during the irrigation season, and lasted ten years. We had no trouble at all for two years, when one day there came a noise from the transformer house like a bombardment of cannon, flames shot out and the whole thing went up in smoke. The catastrophe was due to over-heating of the transformers. However, we rebuilt at once, this time installing oil-cooled transformers and doubling the capacity of the first installation. Also, we housed them in a brick building which still stands. We have been using power ever since and our installation is rated at the present time at 300 horsepower. We have never had reason to regret our experiment in the direction of rural electrification."

"Pacific Service" Plays an Important Part in the Marble Quarrying Industry

By WARD C. SCHAFER, New Business Department, San Joaquin Division.

Somewhere back in the dim vista of our grammar school days we learned that Vermont was chiefly noted for its marble quarries. Here in California, with our multiplicity of products where none can really be called chief, we are prone to overlook our less spectacular industries and waste the fragrance of our superlatives on products that are already well sold to the world at large. Yet, tucked back in our mountain gorges are industries which shine just as brightly in the light of publicity as their better known sisters of the plains and sea coast.

Those of you who remember the old Palace Hotel in all its pristine glory will probably recall the marble sidewalk that surrounded it. In all of its 43 years of service only one slab of the Columbia marble succumbed to the terrific wear and tear of that busiest spot of the old city.

Historical Background.—Both the Columbia Marble Company and its product take their name from Columbia, probably the most picturesque deserted city of the Mother Lode. The Columbia of today lies scattered among the scrub pines and oaks of a little mountain flat four miles north of Sonora, dejectedly covering the pathos of its desertion with a futile attempt to link the old with the new. In the spring of 1850 gold was discovered near Bell quarry. In six weeks the flat in the mountains had become a city of six thousand people. At the peak of the rush Columbia reached a population of forty thousand and supported as a by-product of her mines 143 faro banks with a combined capital of $1,500,000. Since then, in common with most of the other Mother Lode cities, Columbia has grown with reverse English to a population of seventy-five or a hundred people! The only sign of a transition from a glorious past to a more glorious future is a gasoline and oil station located on the site of an old dance hall.

Soon after the Civil War a few of the hardier souls who sought a less fickle goddess than the elusive gold formed the Columbia Marble Company and opened the now deserted quarry where the deposit outcrops in the canyon of the Stanislaus about three miles north of Columbia, and started shipping their product into San Francisco. Thus the cycle was completed over fifty years ago. Columbia gold, traded in retributive justice for Columbia marble, embellished the last prospect hold of the "Forty-niner" in the old Cypress Lawn mausoleum.

In the early days as now, transportation was the chief problem. The first answer to the question was steam. The old Holt Steam Tractor No. 8 still stands rusting on the hill behind the quarry after 45 years of service, as obsolete as the ox-cart beside the seven-speed tractor of today. Before the Sierra railroad penetrated the mountains to the company's present shipping point at Jeffersonville, the old Holt led a string of three broad-wheeled ten-ton cars to Oak-



The mill of the Columbia Marble Company. Here the blocks from the quarry are sawn into slabs and stacked in the yard for shipment.

dale. Three days were required for the round trip of eighty miles. When the roads were heavy, an auxiliary tractor was hooked onto the back end, and, furnished with steam from the Holt up in front, formed a primitive "push and pull" system. Today a motor truck hauls the same load in a day.

Geology of Marble.—All this becomes contemporary history when we consider the age of marble itself. Somewhere back in the "pre-Tut" days when the Sierras were high points in the Pacific Ocean, a colony of minute shell fish died and came to rest in what was in some distant age to be the canyon of the Stanislaus. If they had exercised a little more foresight and located their graveyard on a railroad siding they would have been much more valuable to posterity, for posterity has not, as yet, brought the railroad to the mountain. During the age-long years when the giraffe was developing a long neck, the elephant a long nose, and the horse was losing its toes, the calcareous remains of the little shell fish had been covered with millions of tons of sediment and carried high out of the Pacific into a volcanic ridge of new mountains. Due to the pressure of the superimposed strata of sediment, the foraminafera had already become limestone. About the time our own ancestors were swinging by their tails, some gigantic cataclysm cracked the bedding plane and allowed either lava or superheated water to come in contact with the stratum of limestone formed by our ancient friends the foraminafera. This changed all their preliminary arrangements for, instead of continuing to be limestone, as they did about three miles south of Sonora, they became metamorphic limestone or marble at Columbia. Man, with the aid of fuel-oil and steel can make limestone into quicklime by driving off the carbon dioxide with heat, but nature, with neither oil nor steel, can make limestone into marble with the simple addition of hot water, or hot rock, and pressure:

Limestone+Heat=Quicklime.
Limestone+Heat+Pressure=Marble.

Somewhere in the process a purely local condition occurred which caused the marble to be harder and more firmly crystallized than other domestic marbles. So we come out of the transition with an extremely durable product that will take an extraordinarily high polish. Where ordinary marble has a crushing strength of 14,000 pounds per cubic inch, Columbia marble will withstand 25,000 pounds per cubic inch. In this way the shell fish remove the sting of their commercial inaccessibility by adding a marketable quality, thus trading a shipping point for a selling point.

The different colors and markings in the marble were caused by the intrusion of mineral or organic matter at the time of the metamorphosis. Graphite, which, by the way, is metamorphic coal, gives the delicate grey tones and markings; iron gives the tans and yellows; copper the greens and blues. Nature with an ever present decorative sense traced her colors in marble with a fine brush, while in the Grand Canyon of the Colorado, with the same pigments, she laid them on with a metaphoric fire hose.

On the 140-acre property of the Columbia Marble Company, twenty-one different varieties of marble have been found, blue, blue-white, grey, grey-white, black, variegated combinations of all of them, and ending up with a pure white statuary marble that is the equal of any statuary marble in the world.

Quarrying.—Marble is quarried out in benches. For the purpose of illustration, picture your front steps as marble and mag-



The Columbia Marble Company's quarry near Sonora. This view shows the bench method of quarrying. The 1200-foot cable lift to the mill is shown in the right-hand corner.

nified about sixteen times. In order to quarry them in the orthodox manner, we start with the top step, about three feet in from the edge and drill holes with a pneumatic drill about an inch apart and parallel with the edge of the step. Then we drill holes horizontally on the level of the next step to meet the bottoms of the vertical drills. The block thus formed is broken out along the line of the holes with wedges—dynamite would either shatter the ledge or crack the block. On the next step the same procedure is followed, and so on until the entire mass is quarried out. In the actual quarrying operation the problem is intensified because the benches must be cut away from the retaining side walls. "Pacific Service" answers the question by driving a 12-horsepower motor on the channeler. This machine operates like a traveling trip-hammer, cutting out the long, narrow channel with a jagged-mouthed bit, the chips and dust being carried away by a stream of water which flows down the swath from above. A huge boom hoist, driven by a 10-horsepower motor, lifts the blocks out of the quarry and deposits them on cable-way cars by which the block is delivered at the end of a 1,200-foot lift to the mill. The cable hoist is driven by a 20-horsepower motor.



Auxiliary tractor formerly used for hauling over heavy roads.

Sawing and Sorting.—At the mill the blocks are "sawed" into slabs. The word "sawed" is used advisedly in a descriptive rather than a literal sense. Picture a saw whose teeth are not attached to it, but rather roll in the swath, are washed out by flowing water, pumped up overhead and returned into the swath to be rolled back and forth again by their detached member. The process is somewhat reminiscent of a set of "store teeth" put to soak every night on the window sill. However, the point of difference lies in the fact that the teeth are minute super-hardened steel balls that would hardly be affected by any degree of soaking. The "saws" are operated in gangs of twenty or thirty, depending on the width of the block, and are set to cut from eight to twelve inches in twenty-four hours. Thus each block requires from a week to ten days to complete its transition to slabs and squares. The reciprocating motion of the saws is delivered from eccentrics which are in turn powered by the main drive shafts. Two heavy gangs are driven by a 20-horsepower motor, three intermediate gangs by 30-horsepower, and three light gangs by a 25-horsepower motor.

After the sawing process is completed the block is transferred to another part of the yard, where each slab is scrubbed and cleaned preparatory for shipment. Due to the viscissitudes of mountain travel, the slabs are not polished until they reach the end of their journey. However, the quarryman has something to say about the final assembly, for he is the one who numbers each slab as it stood in the block, thus making it possible to match the slabs so that we can adorn our public buildings with fantastic landscapes in marble.



Motor-driven boom hoist in the quarry.

The installation of Columbia marble in the Insurance Exchange Building in San Francisco is a beautiful example of such matching. Other installations of Columbia marble in San Francisco can be seen in the Merchants' Exchange

Building, the Rialto Building, the Alaska Commercial Building, and the City and County Hospital. Commuters will be interested in knowing that the new marble floor in the Ferry Building represents 30,000 square feet of Columbia marble chosen because of its hardness and durability as flooring. The floors in both the White House and the Emporium are also of Columbia marble.



Type of car used before the railroad came in.

The Broderick monument in Laurel Hill Cemetery is probably the oldest installation of Columbia marble in San Francisco. The block for the monument was quarried in one piece and hauled intact to Stockton by teams for transshipment by water. At Stockton, however, the gigantic slab proved to be too big for the boat, so it was cut in two on the dock and thus continued its trip—disjointed, but through no structural defect of its own. Further witness of its hardihood was furnished by the earthquake in 1906, which was able to move the monument a half inch on its base, but could not crack it or shake it down.

The potential supply of crude marble is practically unlimited. It is estimated that on the 140-acre property of the Columbia Marble Company alone there are 80 million tons within a depth of 100 feet, enough to cover 400 square miles of walls and floor.

Marble and "Pacific Service." — It is difficult to imagine the Columbia Marble Quarry as a thing apart from "Pacific Service," for every wheel and moving part is hooked up either directly or indirectly with the intangible power of falling water. The company is at present operating on a total connected load of 208½-horsepower, approximately half of which is operative for twenty-four hours a day. The demand factor of the plant is 70 per cent; that is, the greatest consumption during any recorded fifteen-minute period of operation is only 70 per cent of what it would be if the installation were crowded to full capacity. Another way of saying practically the same thing is that the plant factor is 26.2 per cent. In other words, the actual consumption is 26.2 per cent of the possible consumption. The actual consumption averages 29,900 kilowatt hours per month or 143½ kilowatt hours per connected horsepower.

While "Pacific Service" is working day and night for the Columbia Marble Company, the reverse is also true. The latest and probably the most beautiful variety to be uncovered is the new "Portola" marble, which has been used in the Pacific Gas and Electric Company's new general office building in San Francisco. The "Portola" is a richly tinted buff marble, carrying a tracery of electric blue veins—nothing like it has ever been uncovered in the history of quarrying. Aside from its salient characteristics, its own intrinsic beauty renders it a fitting monument to the bond of mutual usefulness between the two companies.



General view of the quarry, showing bench operation.

Peninsula Development Aided by "Pacific Service"—Devonshire Hills

By F. A. PECK, Sales Supervisor, Redwood District

San Francisco, queen city of the Pacific, is rapidly reaching its maximum housing capacity and still its expansion continues and bids fair to continue indefinitely. Bounded as it is on three sides by ocean and bay there is but one direction in which it can expand territorially and that is down the peninsula.

Many new residential communities have come into being on the peninsula in the past two years. A typical example of this activity is to be found in the hills just west of San Carlos. A little over a year ago cows grazed leisurely in the quiet of "Hidden Valley." Today that beautiful valley and its surrounding slopes are alive with the spread of a new settlement known as Devonshire Hills. Drives and roadways have been constructed and already many new homes are occupied and many more under construction.

Located on the crest of one of the highest knolls in Devonshire Hills is the Devonshire Country Club, membership in which is limited to property owners in Devonshire Hills. The clubhouse is undoubtedly one of the most attractive of its kind in California. Everything is of the most modern, and it enjoys distinction as one of the very few clubhouses on the Coast with full electrical equipment.

At night, the clubhouse can be seen for miles from the highway. Powerful flood lights illuminate the exterior of the building. Cooking is done by means of a 22 K. W. Standard electric range. Hot water is obtained for all purposes by means of 26 K. W. of Wesix water heaters. Heating of the building is accomplished by means of 100 K. W. of Wesix air heaters. Among the other electrical devices in use are: dish washer, waffle irons, and electric refrigerators. An additional cooking load of 44 K. W. is also being provided for. Service to the building consists of three wires of 850,000 circular mills each of approximately one inch diameter. C. W. Larue of the Redwood District sales department and E. J. Powers, electrical heating engineer of Oakland, aided in drawing up electrical specifications, and selecting electrical equipment.

The growth in Redwood District is rapid. In close proximity to the Devonshire Hills tract Port San Francisco is being developed on the bay. This gigantic enterprise involves an expenditure of approximately five millions of dollars and, when completed, the largest seagoing vessels will dock at its piers. Enormous warehouses will be constructed and large manufacturing industries will locate in this new commercial center. An electric dredger will be used for digging the channel, and electricity will be used extensively in the industrial plants.



Devonshire Country Club, Devonshire Hills

Gas, The Industrial Super Fuel

By J. H. GUMZ, Industrial Gas Engineer

The industrial use of gas, even though it has grown to considerable proportions, is still a comparatively unimportant means of heating when measured against other fuels. Recent statistics show that the heat requirements of industry are met by fuels approximately in the following proportions: manufactured gas, 2 per cent; natural gas, 4 per cent; anthracite coal, 5 per cent; oil, 12 per cent; coke, 14 per cent; bituminous coal, 63 per cent.

The use of manufactured gas is the lowest on the list, but when it is appreciated that the two per cent of the fuel used by industry represents something like twenty per cent of all the gas manufactured in the United States the amount is not so small. Throughout the country there is annually used approximately eighty billion cubic feet of gas for industrial purposes. In revenue this amounts to some $80,000,000 annually for gas companies. Any class of business representing an annual expenditure of $80,000,000 must of necessity be regarded of primary importance. This is not only from the viewpoint of the seller but, also, from that of the buyer.

American industry is today conceded to be well in advance of that of the world in general, due in part to world economic conditions and in greater part, perhaps, to the ability of the men running it. Therefore, if our industry is what it is, due to the ability of its men and these men see fit to spend $80,000,000 annually for gas, it is a natural conclusion that such expenditure is profitable.

With such a large and extensive use of gas by industry almost everyone must more or less directly come in contact daily with some phase of the gas use or with the finished product of it. It might be of interest to consider a few commonplace things which we are apt to take for granted without a passing thought of the possible part gas may have played in their production or preparation.



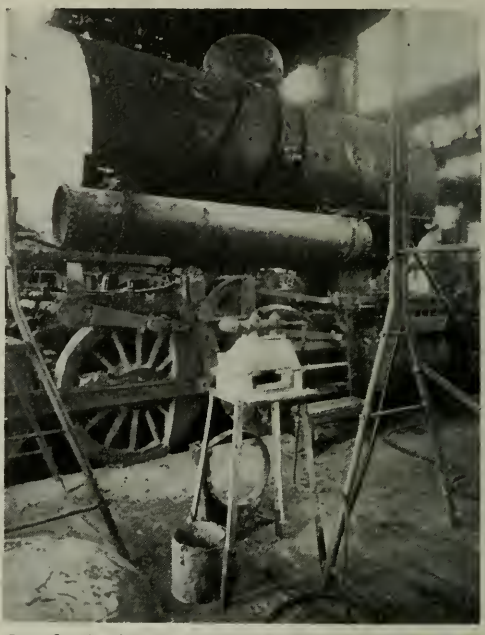
Manufactured Gas has displaced acetylene in cutting up and scrapping obsolete battleships at Oakland shipyards. Fourteen ships have been scrapped in Oakland yards in the past three years

Let us say your morning coffee was roasted with gas and the bread for your toast was baked in a gas oven. Tiny needle-like gas flames permit electric light bulbs to be sealed after the air has been exhausted from them. The finish on your automobile was probably baked in a gas-fired oven and the many steel parts heat treated in gas furnaces so they would have a maximum strength and life. The bottle in which the cream for your morning

coffee came may have been heated with gas as it was being made or, if you use condensed cream, the can from which it was poured certainly was made with gas. Your favorite newspaper was printed from metal type which was melted with gas.

These are just a few of the over 2,000 different uses to which gas is put in industry and more are being developed each day. For instance, gas is used for scorching paint so it can be easily and quickly scraped off of cars in railroad paint shops. Also it is used in the hatching of chickens, and after hatching in keeping the chicks warm during the cold frosty nights—even better than the old mother hen could have done.

According to the records of the Pacific Gas and Electric Company, at the end of 1925 some 4090 consumers made use of gas for industrial purposes. These 4090 consumers represent slightly more than one per cent of the more than three hundred and sixty thousand consumers of all kinds being supplied with gas by the company. On an average, each one of these consumers is more than twelve times as valuable to the company as the ordinary domestic consumer. Some are tremendously more important than this, however. One consumer in San Francisco each month uses as much gas as is used by many small towns having a population of ten or fifteen thousand.



Gas-fired rivet heaters in use at the Western Pacific shops in Sacramento

Fuel surveys made in the territory served by the Pacific Gas and Electric Company indicate that if only as small a proportion as five per cent of the heating requirements now being supplied by fuels other than gas were converted to gas, the total gas sales of the company would be more than doubled. Obviously, such a conversion cannot be easily brought about nor can it be secured without a great deal of sales anad engineering work. Incidentally, it should be borne in mind that this change to gas involves a change from a relatively cheap and crude fuel to one that is refined and expensive. This, together with the natural prejudice against change, makes the sale of gas highly competitive and difficult.



Two 750-lbs. direct-fired tilting brass furnaces and one 235-lbs. crucible-type melting furnace at the Berkeley Brass Foundry. All melting and heating in this plant is done with gas

As in all competitive businesses, consideration must be given to the price of the competitive article and, also, the price the

user can afford to pay. This means that study must be made toward the establishment of rates which will permit a freer and more extensive use of gas. Naturally, lower rates must be based on lower operating costs but, generally speaking, under existing regulations governing a fixed rate of return on capital investment, the inducement for gas companies to do research work in order to lower operating costs is eliminated. Unless gas companies can retain and share at least part of the savings resulting from lower operating costs we can expect but limited efforts to improve operations and so lower rates. The whole tendency of the day, however, is for regulating bodies to recognize the competitive feature of the gas business and that initiative can not be expected without a due reward.



Ten gas-fired japanning ovens are used in finishing various articles manufactured by the Magnavox Company in Oakland

Among the more than four thousand industrial users of gas supplied by the Pacific Gas and Electric Company are some who make rather unusual use of it. For example, in several shipyards wooden hull ships are periodically placed in dry docks for inspection and painting. In the ordinary course of use, some of the paint is scraped from the hull of the ship, and wherever the wood is exposed under water the ship worm or teredo begins its destructive work. All that is visible on the outside is a small hole, but the worm in time will completely honeycomb a timber without coming to the surface. Before painting over the holes a gas torch is played on it, and as the wood is well water soaked steam is quickly formed, which, penetrating the hole, soon ends the career of the worm.

Another use made of gas is to reduce lead ore. Gas is passed through a heated retort in which there is a quantity of this ore. The carbon in the gas combines with the oxygen in the lead ore, leaving pure lead. Several consumers make use of a process somewhat similar in making the surface of steel very hard. In this case the steel is heated in a retort to about 1750 degrees Fahrenheit and gas is brought in contact with it. The steel absorbs some of the carbon from the gas and this surface absorption makes a skin of very hard and brittle steel, while the inner portion remains softer and tough. Most automobile gears are treated in this manner. In making castings in foundries a mold in sand is made from a pattern, and usually the surface is dried with a gas torch. If the sand were a bit moist the



Gas-fired coffee roasters at the M. J. B. plant in San Francisco. Over 300,000,000 pounds of coffee is imported by San Francisco firms annually and is roasted as shown

molten metal would cause the water to flash into steam with disastrous results.

Another interesting use made of gas is for drying barrels. To make the barrel staves retain their shape they must be steamed and bent to position and then dried. With the use of gas there is no discoloration and the barrel is ready for use without the need of cleaning. Cleanliness is an important factor if barrels are to be used for sugar and like products.

In California a State law provides that before a second-hand mattress or pillow can be sold it must be sterilized with heat. A San Francisco concern has an ingenious gas-fired oven for doing this work.



Gas is used to expand locomotive tires in setting and removing them from locomotive drive wheels

Some of the more common uses of gas for industrial purposes in the Pacific Gas and Electric Company territory are for baking purposes. These vary from baking bread in wholesale quantities of 6000 loaves per hour to baking japan on automobile fenders. The coating of metal with japan and the baking of it is well illustrated in a San Francisco factory making bed springs. The springs are dipped in the japan and after hanging over a drainboard for a short time are carried on an overhead trolley system into one of several ovens which are twenty-two feet long. Here high-pressure gas burners that are automatically controlled by a thermostat quickly heat the oven and springs to the desired temperature. After a predetermined interval the springs are run out of the far end of the oven and after cooling are ready for shipment.



Gas-fired locomotive spring furnace at the Western Pacific shops in Sacramento. Absolute control of temperature and doubled production

The baking of cores in foundries in gas ovens is another use of gas which is quite general. One foundry has ovens equipped with temperature control devices so excessive temperatures are impossible. As this foundry does much of the core baking at night the ovens were also equipped with a clock arrangement so that the gas is automatically shut off after having been on for the desired length of time as determined by the core room foreman when lighting the oven. Incidentally, each of these ovens has a capacity of from six to eight tons of cores per night and the gas used averages a fraction under one cubic foot per pound of cores.

The heat treatment of metals covers another large classification of gas use. The temperatures used vary from 200 deg. F. to as high as 2400 deg. F., and the operation may be forging, tempering, annealing or hardening. As the use varies, so does the size of the furnace. Perhaps the smallest furnaces are those having openings two by four

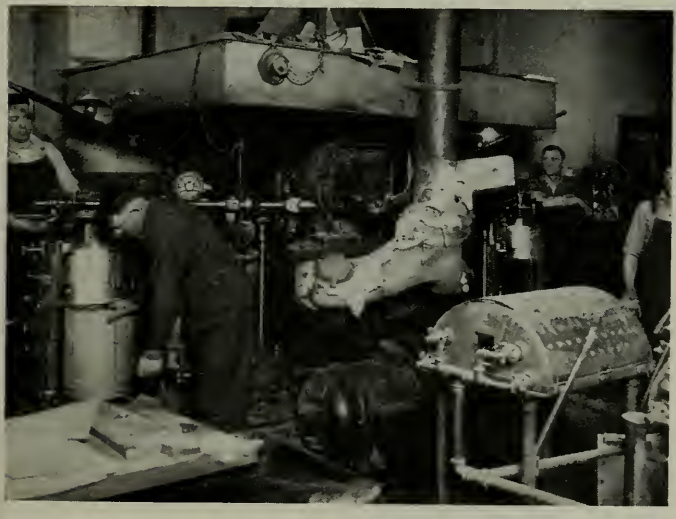
inches and with a depth of eight inches. The largest furnace on the company's lines both from a standpoint of size and hourly demand is an annealing furnace in a railroad shop. The particular furnace is ten feet, one and one-half inches wide, fourteen feet, seven and one-half inches long and three feet high. It operates at an extreme temperature of 1900 deg. F. and has a maximum hourly gas consumption of 10,560 cubic feet. Steel plates one-half inch in thickness and weighing over 1800 pounds are heated to 1800 deg. F. in twelve minutes. The most recent furnace for the heat treatment of metal is one installed at the Mare Island navy yard. The furnace is a steel tank eight feet long, twelve inches wide and four feet deep, filled with a salt compound and heated with eight high-pressure gas burners thermostatically controlled. The salt bath is operated at from 650 deg. F. to 950 deg. F. in treating duraluminum, that new and remarkable metal having the weight of aluminum and the strength of steel.



Battery of gas-fired core ovens at the Standard Brass Casting Company's plant in Oakland

In the melting of metals gas has a very wide field. Practically all newspapers melt their type metal in gas-fired furnaces. Plants making storage batteries also use it for melting the metal used in making the battery plates. One of a number of brass foundries has a direct gas-fired furnace with a capacity of twenty-four hundred pounds of brass at one charge. From this the furnaces range down to less than 100 pounds capacity.

Fundamentally, gas is used because by its use it is possible to obtain a better product, or a larger volume, or labor may be saved, or for any one of a great number of reasons, all of which finally resolve themselves into a lower unit cost to the finished product. Referring again to the tabulation of various fuels given in the above, it is obvious that displacing but a small portion of other fuels would increase the industrial use of gas tremendously. This displacement of liquid or solid fuels is progressing, as cost analyses show that the point always to be considered is not so much the cost of the fuel but what it costs to use it.

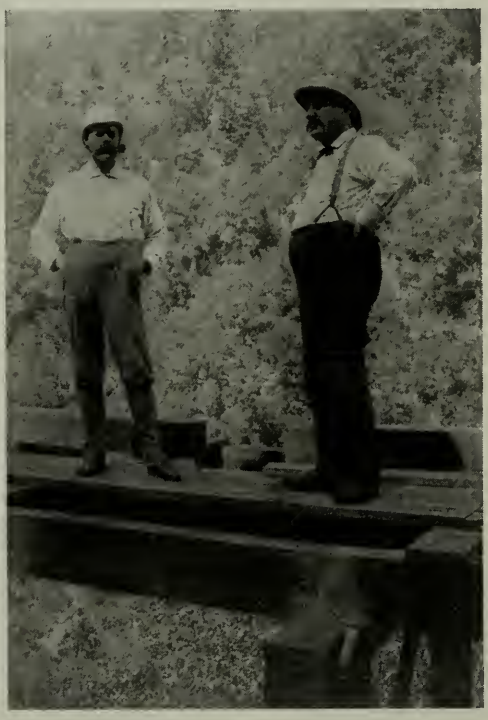


Stereotype melting equipment at the Oakland Tribune. Gas-fired

The Late R. R. Colgate— Pioneer of "Pacific Service"

A newspaper dispatch dated Sharon, Conn., January 7th, reported the death of Romulus Riggs Colgate, one of the earliest developers of hydro-electric power in California and who gave his name to one of the most important water-power plants in our company's system.

Mr. Colgate was associated with Messrs. Eugene de Sabla and John Martin in the organization and development of the Nevada County Electric Power Company and the Bay Counties Power Company, two hydro-electric enterprises that really formed the nucleus of what is now known far and wide as "Pacific Service." Mr. Colgate came from an enterprising family. His grandfather was the founder of the famous soap and perfume business that bears his name, while his father founded the Atlantic White Lead Company, operating a large plant in Brooklyn, N. Y. Romulus Colgate followed the business of his father, and when the National Lead Company took over the Brooklyn plant he was made a policy director of the major concern, an office he held to the day of his death.



Romulus Riggs Colgate (left) and John Martin (right) on the flume at Colgate development

He was also engaged in mining, and had interests in the Auburn and Grass Valley territory. It was on a visit to the Pacific Coast in 1896 to inspect his holdings that he met Eugene de Sabla, who told him of his hydro-electric projects and suceeded in interesting him to such an extent that he agreed to become a partner in the enterprise. Mr. E. W. Hopkins was president of the newly-formed Nevada County Electric Power Company, which was constructing a plant on the South Yuba to supply water for the mines, and it was through the purchase of Mr. Hopkins' stock that Mr. Colgate acquired his financial interest. The South Yuba plant was built and was given the name of Rome power house in honor of "Rome" Colgate.

In the following year, 1897, Mr. John Martin started the construction of the Yuba power plant, in Brown's Valley, eighteen miles from Marysville, and this he did with the financial assistance of Mr. Colgate. Then, in 1899, came the more ambitious hydro-electric enterprise which was given the name of Colgate and is historical for the reason that here for the first time in history high-voltage transmission was put into practice. The power from Colgate was transmitted first to Sacramento, a distance of sixty-one miles, at 34,000 volts and, later, a distance of one hundred and forty miles to San Francisco bay at the never before attempted pressure of 60,000 volts. That accomplishment was the first linking of the water-power of the Sierras with the cities of the Coast.

In 1903 Messrs. de Sabla and Martin, Colgate and others organized the California Gas and Electric Corporation through

an amalgamation of the Bay Counties and Valley Counties Power Companies, the California Central Gas and Electric Company, the Sacramento Electric Gas and Railway Company and the Oakland Gas Light and Heat Company. Subsequently Mr. Colgate withdrew from the organization, his interest being purchased by Mr. Frank G. Drum, who later became president of the Pacific Gas and Electric Company and served in that capacity until 1920. After his retirement Mr. Colgate resided entirely in the East. For two years prior to his death he was in very poor health. He was 67 years of age when he died.

Mr. John Martin, who is generally credited with having done more than any other man to make hydro-electric development a practical and commercially successful undertaking, gives Mr. Colgate unstinted praise for his courage and abiding faith at a time when the fate of their venture hung in the balance. Upon learning of his old friend's death, Mr. Martin said:

"No one knows better than myself how much the power industry of California owes to Romulus Riggs Colgate. He was primarily as much responsible as myself for the happy solution of what was in the beginning a very difficult problem. His persistent encouragement, to say nothing of his financial aid, carried us along the road to success."

In Memoriam—Charles W. McKillip

Born August 19, 1860 *Died November 21, 1925*

With deep regret we record the passing of Charles W. McKillip, manager of Sacramento district, who died November 21st last, aged 65 years.



"Charlie" McKillip

"Charlie" McKillip was one of the old guard. His connection with "Pacific Service" dated back to its predecessors in Sacramento, the Capital Gas Company and the Sacramento Electric, Gas and Railway Company, and altogether his term of service in the public utility business was thirty-seven years. He was employed in various capacities, from meter-reader, collector and superintendent of street mains to district manager, a position he held for nineteen years. He was a master of detail, a tireless worker and loyal to a degree. He was born, lived and died in the capital city and it is safe to say that no man was more beloved of those who knew him. He served as a member of the Board of Supervisors of his county from 1904 to 1912 and was highly esteemed as a competent and trustworthy official. On the day of his funeral Mr. C. K. McClatchey, editor and publisher of the *Sacramento Bee,* penned the following tribute to his worth:

"Today all that was mortal of 'Charlie' McKillip was put back into the earth from which he sprang.

"No eulogy from this pen could be more appropriate than these lines by Fitz-Greene Halleck:

" 'Green be the turf above thee
Friend of my better days;
None knew thee but to love thee,
Nor named thee but to praise.' "

So say we all.

The Financial Side of "Pacific Service"

Following is a preliminary statement of the Company's income account for the calendar year 1925, compared with the preceding year:

	1925	1924	INCREASE
Gross Revenue, Including Miscellaneous Income	$48,066,897.07	$44,934,683.31	$3,132,213.76
Maintenance, Operating Expenses, Rentals, Taxes (including Federal Taxes) and Reserves for Casualties and Uncollectible Accounts	28,898,712.05	28,203,096.28	695,615.77
Net Income	$19,168,185.02	$16,731,587.03	$2,436,597.99
Net Interest Charges	7,078,183.24	6,261,527.61	816,655.63
Balance	$12,090,001.78	$10,470,059.42	$1,619,942.36
Bond Discount and Expense	430,654.27	384,293.42	46,360.85
Balance	$11,659,347.51	$10,085,766.00	$1,573,581.51
Reserve for Depreciation	3,807,990.49	3,057,416.54	750,573.95
Balance to Surplus	$ 7,851,357.02	$ 7,028,349.46	$ 823,007.56
Preferred Stock Dividends (6%)	3,266,606.35	3,252,118.12	14,488.23
Balance	$ 4,584,750.67	$ 3,776,231.34	$ 808,519.33
Common Stock Dividends (8%)	3,624,337.36	3,040,122.70	584,214.66
Balance	$ 960,413.31	$ 736,108.64	$ 224,304.67

According to our usual custom, a detailed analysis and explanation of the Company's operations and finances will be given at the annual meeting of stockholders to be held on April 13th, 1926, and in the pamphlet annual report which is mailed to every stockholder. In the meantime, the outstanding features of the year's business may be summarized as follows:

(a) Business conditions were somewhat unfavorable during the first half of the year; but notwithstanding this, and in spite also of reductions in gas rates elsewhere referred to and aggregating $300,000, and a smaller irrigation load due to improved water conditions, gross revenue from all sources increased $3,132,214. The gas and electric departments contributed about equally to this increase.

(b) In conformity with the policy established by the Railroad Commission of California, under which gas rates are automatically increased or decreased to conform to changes in oil prices, two reductions in gas rates were made as of October 22nd and November 26th, 1925, respectively. Since the institution of this policy in August, 1921, there have been four increases and five decreases in gas rates, with net benefits to our gas customers ranging from 10 cents to 22 cents per thousand cubic feet, depending upon the locality and rate schedule under which service was taken. These reductions in 1925 represented a saving to our customers of $300,000 in the last ten weeks of the year. Our gross revenue was diminished by this amount, but the decrease was offset by a corresponding reduction in oil costs. There was no change in electric rates.

(c) Notwithstanding the much larger volume of business, an increase of $572,922 in taxes and of $582,666 in expenditures for maintenance, operating expenses exceeded those of 1924 by only $695,616, or 2.5%. The chief saving during the year was in fuel oil costs, owing to the larger supply of hydro-electric energy resulting from improved water conditions, and the completion of Pit Plant No. 3.

(d) Net income increased $2,436,598, or 15%.

(e) Bond interest was earned 2.71 times, with a margin of $12,090,002 over interest requirements. This very substantial balance over interest charges was upwards of $1,400,000 more than during any other year in the Company's history, in spite of the fact that interest charges in 1925, due to the investment of many millions of dollars in additional operative properties, exceeded those of 1924 by $816,656.

(f) The Company's properties were maintained during the year at their usual high degree of operating efficiency, the total provision for upkeep—that is, combined maintenance charges and reserve for renewals and replacements—aggregating $7,337,120, an increase of $1,333,240, compared with 1924.

(g) After the payment of the usual 6% dividend on preferred stock to over 20,000 holders of this issue, there remained a balance of $4,584,751 available for common stock dividends, or $10.12 per share upon the average amount of common stock outstanding, and an increase of $808,519 over 1924. The amount paid in dividends to common stockholders during the year was $3,624,337, or $584,215 more than in the preceding year, this increase being due to the fact that the Company's construction program, involving the expenditure last year of upwards of $25,000,000, was partially financed through the sale of common stock.

Common stock dividends at the regular rate of 8% were paid throughout the year, and a balance of $960,413, or $224,305 more than in 1924, was added to surplus account.

(h) From the standpoint of physical operations, it may be briefly said that the net addition of new customers was 50,081, of whom 35,760 were added in the last six months of the year. The number of consumers taking service from the Company's lines at December 31, 1925, was 813,698.

A new water-power plant, Pit No. 3, with an installed capacity of 108,579 h.p., the largest so far constructed by the Company and one of the most powerful hydro-electric installations in the country, was placed in operation in August, 1925. With this addition, the Company is assured of an ample supply of electricity regardless of weather conditions. The recent rain and snowfall has still further improved our situation in this respect.

NOTICE TO COMMON STOCKHOLDERS

The Board of Directors of the Pacific Gas and Electric Company at its meeting on Wednesday, December 9th, 1925, approved President Creed's plan for the sale to existing common stockholders of an additional issue of common stock. Under this plan, common stockholders will be given the right to subscribe to the new issue at par, and to the extent of 10% of their present holdings. The total amount of new stock will be somewhat less than $5,000,000. The Railroad Commission of California has authorized the issuance of this stock, and the remaining details of the plan will be worked out and formal announcement made to stockholders in the immediate future.

President Creed states that it is the Company's plan to finance its future capital requirements in the approximate ratios of 50% from bond sales, 25% from preferred stock sales and 25% from offerings of common stock at par to the common stockholders of the Company. The effect of this will be to still further improve the Company's capital structure and to place it on a parity with the most conservative in the country. It will, therefore, be the Company's policy to follow this offering of common stock with similar offerings at intervals as required by the expansion of its business. It cannot, of course, be definitely foretold at what intervals additional offerings will be made or the amount thereof, as this will depend upon the amount of new capital required for plant extensions, but it may be anticipated that they will occur about once a year.

Widening Savings Bank Investment Field

Utility Securities Offer Safety of Investment, High Return and Marketability, And Should Be Legalized As Savings Bank Investments.

By E. J. BECKETT, Assistant Treasurer, Pacific Gas and Electric Company.

Public utility securities, particularly those of electric light and power companies, are enjoying an era of popularity never before experienced in the life of the industry. Over two million investors in the United States now own the stocks and bonds of electrical utilities, these companies in the last eleven years alone having sold over three-quarters of a billion dollars worth of stock direct to 950,000 investors under the customer-ownership plan, aside from the hundreds of millions of dollars of utility issues which are annually distributed through investment banking channels. The insurance companies, as well as National Banks, well informed and careful investors, have added enormously to their holdings of public utility bonds in recent years. The following summary of national bank investments in railroad bonds and in the bonds of public utility companies indicates the very large relative increase in the latter class of investment during the past fifteen years.

INVESTMENTS OF NATIONAL BANKS*

	RAILROAD BONDS	OTHER PUBLIC SERVICE CORP. BONDS
1909	$342,525,000	$151,999,000
1914	341,690,000	218,215,000
1924	573,571,000	397,560,000
Increase in 15 Yrs.	$231,046,000	$245,561,000
Increase, %	67.5%	161.5%

In view of these facts, and of the generally recognized strength and stability of the public utility industry, it seems inconsistent to record that *the savings banks of the country, which are responsible for the safe investment of savings deposits aggregating many billions of dollars, are only in a comparatively few states legally permitted to invest their funds in bonds of public utilities.* The latest report of the Comptroller of the Currency states that at June 30th, 1924, there were 13,972,000 depositors in the mutual and stock savings banks of the United States, with total deposits of $8,439,855,000. *It is only through the safe and intelligent investment of this immense amount of money that the banks are able to make interest payments to their millions of depositors, and yet they are debarred by law in many of the wealthiest and most populous states in the Union from investing in what is unquestionably one of the largest, most progressive, most essential and most stable industries in the entire country.*

Present statutory restrictions governing savings banks investment are widely divergent, and full of inconsistencies. However, the laws of most states permit of placing these funds, with certain limitations, in United States Government bonds, state, county and municipal issues, railroad bonds and real estate mortgages. Only in California, Colorado, Connecticut, Maine, Massachusetts, Michigan, New Hampshire, New Mexico, Rhode Island, and Vermont are saving banks specifically permitted to invest in utility issues able to comply with certain conditions; and of these states, Michigan restricts investment in public utility securities to bonds of companies incorporated in that State, and Colorado, Massachusetts, and New Mexico allow only investment in first mortgage bonds.

The ideal investment combines absolute security of principal and a ready marketability with as high a yield as it is possible to obtain with safety, and in these respects the better grade of utility company bonds offer an exceptionally desirable field. United States Government bonds, for example, possess the attributes of safety and of marketability, but the yield is lower than the interest rate which the majority of savings banks pay to their depositors. State and municipal bonds also afford a comparatively low yield, largely on account of their tax-free feature, which is of no

*Figures extracted from annual reports of the Comptroller of the Currency.

particular benefit to institutional investors. First class real estate mortgages fulfill the requirements of safety and reasonable yield, yet generally possess only a limited degree of marketability. Railroad bonds as a general rule afford a smaller return than the same grade of utility issues. The admissibility of public utility bonds as legal investments for savings banks in all states would permit these institutions to diversify their investments to a larger degree than is now possible, and would also enable them to secure a higher average yield upon their investments. This in turn would reflect to the advantage of their depositors, since the interest rate paid upon deposits is primarily governed by the return which the banks are able to earn upon the funds so invested. The electric and gas companies of the country would also benefit exetensively from such a situation. *If only 15 per cent of all savings deposits in banks were permitted to be invested in the bonds of utility companies, this would mean that these institutions could absorb two and one-half billion dollars worth of these securities. As conditions now exist, less than one billion dollars worth of utility issues are now held by the banks of the country, of which not more than one-fourth are owned by mutual and stock savings banks.*

The electrical industry is, generally speaking, alive to the tremendous possibilities offered by the extension of the field for savings bank investments to include public utility securities. A committee under the Chairmanship of Mr. M. S. Sloan, President of the Brooklyn Edison Company, has for some time been actively engaged, in co-operation with Savings Banks Associations and similar bodies, in an effort to secure amendments of the laws of certain eastern states—notably New York, Massachusetts, and Connecticut—so as to permit of modifying the existing statutory restrictions relative to this subject. The laws of the State of Connecticut were very recently revised so as to legalize for savings bank investments the bonds of certain electric and telephone companies. While the statute as now amended is perhaps unnecessarily rigid in its restrictions, it represents at least a start in the right direction. Somewhat similar proposed legislation in Massachusetts, however, quite recently failed of enactment.

No intelligent person will question the desirability of so restricting the investment of savings bank funds as to absolutely safeguard the savings of their millions of depositors. At the same time, the interests of the savings bank depositors themselves will be best served by permitting of such latitude in investment as will at least assure a fair rate of return. In the case of public utility bonds, the tendency in some quarters to limit investment to closed first mortgages or underlying issues of electrical companies will permit of placing funds only in those securities which are already in the greatest demand among all classes of investors, and which yield a comparatively very moderate return. It is an indubitable fact that admission to legality as savings bank investments of other utility issues which are not necessarily absolute first mortgages, but which are nevertheless amply secured by physical assets, possessed of an assured earning capacity and subject to reasonable restrictions as to the issuance of additional bonds, would not only be beneficial to the banks by permitting the purchase of bonds yielding, say, from 5 per cent to 6 per cent, but would be of immense advantage to the public utilities by opening a very large and hitherto unavailable market for the modern type of open-end issue with which a great many companies are doing their senior financing.

It does seem, too, that there is nothing either in the past history or the present prospects of the artificial gas industry which warrants the exclusion of bonds of those companies which derive all or a substantial portion of their revenues from this source. The gas business has proven its exceptional stability throughout a century of growth, and while it lacks in some degree the spectacular development of the electrical industry, it is now on an assured basis of prosperity and continued progress.

Institutional investors, such as insurance companies and banks, have for a great many years been seeking the establishment of definite standards by which the investment value of securities may be gauged. In this

connection, a prominent investment banking house, after an analysis of the existing statutes and of the standards now utilized by various large insurance companies and other institutional investors in their selection of public utility bonds, has suggested the following guiding principles:

1. The bonds must be issued by a public utility company supplying electric light and power, or gas service, or electric light and power in combination with traction service where the latter does not contribute more than 25 per cent of the net operating earnings.

2. The company must serve well diversified types of customers, and it or its predecessors must have shown healthy expansion over a period of at least ten years.

3. The company must operate either under the control of a state public utility commission or under an exclusive and satisfactory franchise which by its terms extends at least three years beyond the maturity date of the bonds under consideration.

4. If the bonds are secured by an open overlying mortgage it must cover all property of the company now owned and hereafter acquired, covering as a first lien some important unit. Such mortgage must provide for the issuance of further bonds sufficient, not only for the refunding of all underlying liens par for par, but also for future additions and betterments, at not over 75 per cent of their actual cash costs or reasonable value, whichever is less. If the bonds are secured by an underlying mortgage it must cover, as a first closed mortgage, used and useful portions of the property and be provided for in refunding.

5. The total mortgage debt shall not exceed 60 per cent of the reasonable value of physical property.

6. Net earnings for a period of 36 consecutive months out of the previous 38 months shall have been equal to at least 1¾ times all present interest charges, including interest on bonds about to be issued, and for 12 consecutive months out of the previous 14 months shall have been equal to at least twice all present interest charges, including interest on bonds to be issued.

7. The company shall show net operating earnings available for interest charges of at least $200,000 per annum.

8. Management must be broad-minded and efficient.

The foregoing tests, while they are of course merely suggestive in nature, appear to be well balanced, sound and practical. They are not intended to reflect the opinion of any single individual, but to represent rather the accumulated experience and judgment of a large number of investors, and might at least form a working basis for legislation governing savings bank investments in bonds of utility companies.

Opinions may differ as to the stringency of the provisions which should be made to govern this class of investment; but when one finds that sixteen of the forty-eight states have no statutory regulations covering the investment of savings bank funds, in many cases leaving this vital responsibility entirely to the discretion of the officers of these institutions, one cannot escape the conviction that, as a mere matter of protection to depositors, legislation definitely outlining in what manner their money may be invested is desirable.

A study of the situation revealed by the appended table, and a consideration of the highly essential part played by the public utilities in our national development, the tremendous amount of financing which is annually undertaken to provide adequate service, and the splendid opportunity for safe and profitable investment afforded by the purchase of their securities, justify the conclusion that *the adoption of definite and, as far as possible, standardized legislation permitting the investment of savings bank deposits in public service corporation bonds is a matter of far-reaching importance, not only to the utilities, but*

to the millions of savings bank depositors who comprise so large a proportion of the American public. The benefits of legislative action along these lines are so obvious that it is almost surprising that more of the wealthy and progressive states have not long ago provided machinery for legalizing public utility bonds. The real cause of delay is undoubtedly occasioned not by any doubts as to the safety and desirability of these securities for savings investments, but by lack of initiative on the part of the banks. Bankers are proverbially conservative, and in many quarters the lack of support on this question springs from an attitude of indifference—their present investments are yielding sufficient to pay their depositors' interest, so why worry? The general public, which in the final analysis is the most interested party, has little or no information on the subject. The average savings bank depositor probably never stops to think that the traditional 4% he receives is really not much more than 2%, contrasting the purchasing power of today's dollar with that of a few years ago and that, in all fairness, the banks to which he entrusts his money ought to make every effort, consistent with safety, to give him more real value than he is receiving. The burden of stimulating legislative regulation of savings banks' investments in conformity with the trend of modern development as regards the utility industry necessarily falls upon the industry itself, and educational work along these lines within the ranks of the industry, as well as outside, is desirable.

Investment by savings banks in public utility securities, under suitable restrictions, is some day going to be legalized in every state of the Union. Just how soon, however, depends on the amount of effort put forth to bring the public and the various state legislative bodies to a realization of the advantages to be gained thereby.

States Having No Legislation Covering Investment of Savings Bank Funds, or Permitting Investment at Discretion of Savings Bank Officials

Alabama	Mississippi
Arkansas	Nebraska*
Delaware	North Carolina
Georgia	Oklahoma
Illinois	South Dakota
Kansas	Tennessee
Kentucky	Utah
Maryland	Virginia

*(Bonds of known marketable value when approved by State Banking Board).

States Having Legislation Limiting Investment of Savings Bank Funds, But Not Permitting Investment in Public Utility Securities

Arizona	New York
Florida	North Dakota
Idaho	Oregon
Indiana	Pennsylvania
Iowa	South Carolina
Louisiana	Texas
Minnesota	Washington
Missouri	West Virginia
Montana	Wisconsin
Nevada	Wyoming
New Jersey	

States Specifically Permitting Investment In Public Utility Securities Able To Comply With Certain Restrictions

California
Connecticut
Maine
Michigan (limited to bonds of Michigan Utilities)
New Hampshire
Rhode Island
Vermont
Colorado (First Mortgage Bonds)
Massachusetts (First Mortgage Bonds)
New Mexico (First Mortgage Bonds)
Ohio (Bonds of any regularly incorporated company)

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERSTS OF THE PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVI JANUARY, 1926 NO. 7

We are living in an era of incessant effort. The pace is swift indeed, and there is no room for the laggard upon life's highway. The year to which we have just bidden adieu was one of marked advancement in every line of industry, yet the one that lies before us promises to be even more eventful.

For an institution like "Pacific Service" there is always something worthwhile ahead, some achievement to be carried out. The public service is an exacting taskmaster and the periods of rest from labor are few and far between. There is reward, however, in the consciousness that we have made progress, that we can look back with Longfellow to "Something attempted, something done"; and so, no matter how hard the way before us we set out upon the journey with light step and resolute heart.

California grows apace and in the territory occupied by our company's operations it is our never-ending task to keep building, building, always building, that the public service may keep its place in the van of progress and development. Our company expended a very great deal of money in construction work in the year just ended, an amount exceeding twenty-seven million dollars. On the electric side the achievements were many and varied. Pit No. Three power plant was completed and put into service last summer. The work accomplished so far in that region has been of immense value to our company in guaranteeing dependable service to our electric consumers. The far-famed Cascades, with their porous lava beds, have justified in every way their reputation and in wet and dry seasons alike, during periods of subnormal rainfall as in those of abundance, the full, even stream-flow of the Pit has never failed.

This latest contribution to the sum of electric energy sent out from the Pit River region has entailed much in the way of reinforcement of our transmission and distribution systems, including additions to high-tension transmission lines, improvements of local distribution facilities, new substations, enlarged equipment in existing ones and other essentials to the adequate service of hydro-electric power; construction work of less spectacular quality than the harnessing of the snow waters in the mountains but all part and parcel of the one great scheme of development and involving the expenditure of many millions of dollars.

And now, in our construction budget for 1926 an important item is the diversion dam at Pit No. Four, the next in order in the chain of Pit River developments, preliminary work upon which was begun last fall. An article descriptive of this latest link in the "Pacific Service" chain will be found elsewhere in this issue. The big job, from the standpoint of time involved, will be the boring of a tunnel approximately four and one-half miles in length.

Another interesting piece of construction work is the projected power plant on the Stanislaus river below the Melones dam. In this work our company is co-operating with the Oakdale and South San Joaquin Irrigation Districts, which are sharing the responsibility of constructing a dam on the river, about ten miles out of Jamestown, which by providing storage facilities to supplement the natural flow of the stream will afford a considerable increase in the water supply for irrigation purposes. Our company's work is to construct a tunnel 4500 feet in length by which water will be conveyed from the dam to a power-house on the river our company will build, own and operate as part of the "Pacific Service" system. Its generating capacity will be about 40,000 horsepower capacity. The irrigation districts estimate that what our company pays for the use of the water for the operation of this plant will pay the interest on their bonds and provide the necessary sinking fund to retire the bonds in twenty-five years. It is expected that the Melones power-plant will be completed and ready for operation by the spring of 1927.

This year, it is expected, will see the completion of the work at Lake Fordyce, the parent reservoir of our company's Spaulding-Drum system in the High Sierras. The additions being made to the height of the dam will more than double the capacity of the reservoir by providing an additional 26,000 acre-feet of water. This will mean millions of additional kilowatt hours for our electric consumers in that section of our company's territory, besides considerably increasing the water supply for irrigation purposes we are enabled to place at the disposal of farmers in the deciduous fruit region of Placer county.

In the same section of territory there will be a renewal of construction activities on the shores of Lake Spaulding, where under an agreement with the Nevada County Irrigation District our company is about to construct a power-plant on the rim of the lake of some 5,000 horsepower capacity. The water to operate this will be delivered to the plant by the irrigation district through conduit from its storage reservoirs on streams tributary to the south and middle forks of the Yuba river, and our company after using the water for power purposes will route it through the "Pacific Service" system, part by the way of Deer creek power-house to Nevada City and Grass Valley and the balance through Drum power-house and others that may be built immediately below it, whence it will be returned to the district at a point above Colfax near the Bear river head-dam. The district will take this water off to the north and use it for supplying the territory at the lower elevations south and west of Grass Valley.

Leaving the Sierra Nevada and travelling in the direction of the Mother Lode our company is daily expecting word from Washington that the Federal Power Commission has formally approved the transfer to us of a license for the development of water power projects on the upper reaches of the Mokelumne river in Amador and Calaveras counties. Our company has acquired by purchase certain properties and accompanying water rights in that region in order to provide additional power and storage facilities for its Electra power system in Amador county.

The Electra system dates back to 1897, when the Blue Lakes Water Company constructed a water power plant on the banks of the Mokelumne river some four miles from Jackson, in Amador county, utilizing as its operating force the water supply from a cluster of lakes in Alpine county, at an elevation of 8,000 feet above sea level, in the vicinity of Border Ruffian, the highest peak in the Sierra Nevada range. The first power plant was destroyed by fire two years later, but was rebuilt and was operated up to 1902, when the Standard Electric Company, predecessor in interest of the Pacific Gas and Electric Company, having taken over the properties of the Blue Lakes Water Company constructed the present Electra power-house on a much larger scale than the other. To the original sources of water supply, known, respectively, as Upper and Lower Blue Lakes, Twin Lakes and Meadow Lake, was added a reservoir formed by damming the Bear river, a tributary of the Mokelumne. These various reservoirs discharge into the Mokelumne river, whose waters are diverted into two canals at a point about twenty miles above the Electra power-house and have been used for the past twenty years to operate this plant with its installed generating capacity of 26,000 horsepower.

The original Blue Lakes installation was made primarily for supplying electric power to the mines in the Mother Lode section running through Amador and Calaveras counties, but, later, when the larger Electra plant was installed, the transmission lines were extended to Stockton and thence to San Francisco, so that the greater part of the output of Electra is now supplied to valley consumers, aiding in the prosecution of industrial as well as agricultural enterprises.

The work expected to be undertaken will involve the construction of a dam on the Mokelumne river, at Salt Springs, approximately four miles up stream from the junction of the river with its principal tributary, the Bear, which flows in from the northward. The dam site is at an elevation of 3,800 feet above sea level and lies in a granite country that is typical of the Sierra Nevada range. Cliffs in excess of 1,000 feet in height rise from the stream on either side of a narrow gorge. The dam itself will be 200 feet in height, of rock-fill formation with concrete face, and will require one million cubic yards of material for its

construction. It will impound the waters of the river to the extent of creating a reservoir of 60,000 acre-feet capacity. From an intake at the dam the water from the Mokelumne will be conveyed by concrete-lined canal and tunnel along the northern slope of the stream a distance of twenty-five miles to Tiger Creek, and from that point will be dropped 1200 feet to operate a new power-house whose electric generating capacity will be around 40,000 horsepower. Having performed this service, the water will be carried on to Electra.

This announcement will bring joy to the hearts of the inhabitants of a considerable stretch of territory in which mining, agricultural, industrial and other interests are largely dependent upon electric power for their successful prosecution. Work will be started as soon as the necessary authority is given, among the preliminaries being the construction of a power service line between Electra and Salt Springs and the opening up of roads for transportation of machinery and supplies.

The foregoing may be taken as the prominent features of a comprehensive electrical construction program that will keep our Engineering Departments busy during the year.

In his opening address to the great convention of the National Electric Light Association in San Francisco last June, President Franklin T. Griffith, himself a Pacific Coast man, voiced the prediction that the light and power industry in the United States will need to raise money at the rate of $2,000 a minute for the next ten years. This money will be needed for power development. Needless to say that "Pacific Service" will play its part in the comprehensive enterprise.

Meanwhile, the Gas Department will be equally active. The extensive home-building program carried on during the past year throughout the territory by our company has made necessary numerous additions to the gas generating plants as well as improvements and extensions of the transmission and distribution systems in order to meet the demands of approximately 22,300 new consumers added to the lines throughout the year, making the total served as of the end of the year in excess of 387,700 consumers.

Approximately $5,000,000 was expended by the Gas Department in 1925 in new construction work. The leading features included two new gas-generators of five million cubic feet capacity each, with additional boilers, compressors and other auxiliary equipment, at the Potrero Plant in San Francisco; a new generator of five million cubic feet daily capacity at the plant in Oakland; new generators at the Sacramento, San Rafael and Fresno plants.

During the past year our company assured improved service to consumers in Sacramento through the purchase of the properties of the Sacramento Gas Company, a concern whose resources include both gas manufacturing plants and natural gas wells from which it has supplied consumers in the cities of Sacramento and Lodi. Union of the plants of the two companies, it is felt, will result in a general improvement through uniformity of service and quality of the product supplied.

A most important work in the direction of improvement of service is the extension of high pressure gas mains from central generating plants to outlying communities. This development of high-pressure systems has proved a boon to many districts in the "Pacific Service" territory that otherwise might not have enjoyed the comforts of gas service.

The 1926 program provides for an expenditure of five and one-half million dollars for new construction work. The major job to be completed this year is a new ten million cubic feet holder, of the "waterless" type, to be erected at the Oakland Works. This holder is required to meet the increasing demand of the section of Oakland lying east of Lake Merritt. Approximately $1,200,000 will be expended in extensions of distribution systems and service to new consumers in the East bay district.

In San Francisco there will be an extension of service systems, including trunk line extensions in the Western Addition and the Sea Cliff, Westwood, Ingleside and St. Francis Wood districts.

It will be seen that our company is anticipating the inevitable growth both in population and in industrial activity of a section of California that is favored by natural and every other essential condition for unusual advancement. A public service corporation is a public servant in every sense of the word. It must be ready when the public calls.

PACIFIC GAS & ELECTRIC COMPANY

A California Corporation

Managed by Californians — Operated by Californians

"Pacific Service" Represents (as of July 31, 1925)

12,038 employed in all departments.

$266,000,000 capital invested in gas, electricity, railroads, steam, water and telephone plants.

59,000 square miles of territory in which it operates—an area greater than that of England and Wales.

35,459 stockholders.

38 counties of the state in which it transacts business.

783,044 consumers served with gas, electricity, water and steam.

2,158,000 people in 38 counties, which is over 50 per cent of the State population.

291 cities and towns in which it supplies service directly and through other companies.

$19,393,420 annual wages paid employes, year ending July 31, 1925.

$3,151,497 taxes, state and county, year ending July 31, 1925.

$1,070,724 taxes, Federal Government, year ending July 31, 1925.

534,818 horsepower developed in 28 electric water-power plants.

190,349 horsepower developed in 4 electric steam plants.

725,167 total horsepower developed in 32 plants.

1,327,438,875 kw. hrs. sold, year ending July 31, 1925. This is equivalent to the effort of 4,425,000 men.

15,903,525,400 cubic feet of gas sold, year ending July 31, 1925.

16 gas plants.

12,502 miles of transmission and distribution lines. Greater than the distance between San Francisco and Calabar, West Africa.

3,992 miles of mains used in distributing gas. Greater than the distance between San Francisco and Bogota, Colombia, South America.

1,100 miles of mains and ditches used in distributing water.

1,100 miles of track of street railway supplied with electric power.

70,340,568,100 gallons of water storage capacity in 109 lakes and reservoirs. This amount of water would supply the City of San Francisco at the present rate of consumption for nearly 5 years.

117,562 acres of land owned in California.

264 parcels of property owned in cities and towns.

5,591,403 barrels of California Oil used, year ending July 31, 1925.

190,458 horsepower in agricultural motors depending on "Pacific Service."

580,836 horsepower in mining, electric railways, manufacturing and other motors depending on "Pacific Service."

38,648 street lamps, gas and electric, lighted by "Pacific Service."

7,507,809 incandescent lamps nightly lighted.

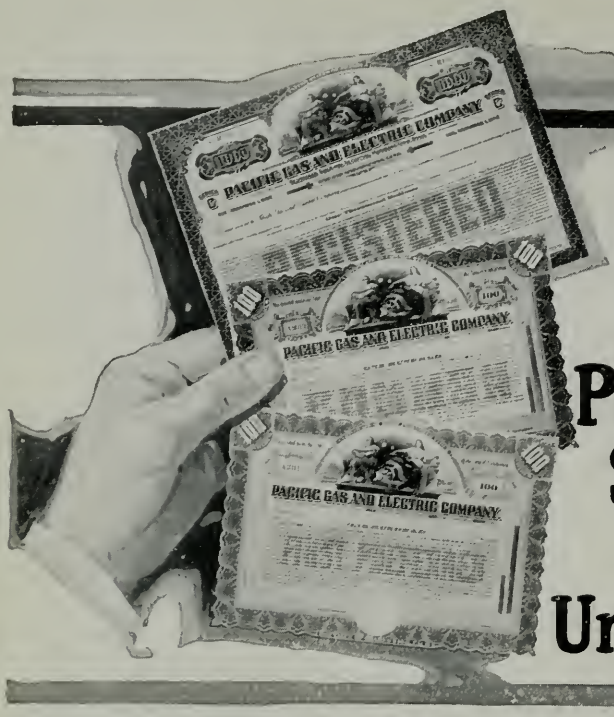
1,441,168 horsepower connected to system.

Pacific Gas and Electric Company

General Office: 245 Market Street

San Francisco

Branches in all principal cities and towns of 38 counties of North Central California.



Three of the Premier Public Utility Securities of the United States

Every One of the

Eighty Thousand Investors

who own

Pacific Gas and Electric Company Bonds and Stocks

receives

Interest and/or Dividends Regularly

Pacific Gas and Electric Company

FIRST AND REFUNDING MORTGAGE BONDS

FIRST PREFERRED CUMULATIVE STOCK (6%)

COMMON STOCK (8%)

are held in high regard by the investing public because

They are securities of one of the largest, strongest and most progressive of the nation's public service companies;

The property securing these issues is worth millions of dollars more than the entire outstanding capitalization;

The Company's business is essential in character, and is increasing steadily year by year;

These securities are always readily marketable. They are listed on Stock Exchanges in San Francisco and other financial centers.

Pacific Gas and Electric Company

STOCK SALES DEPARTMENT

245 MARKET STREET, SAN FRANCISCO, CALIF.

PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO



AIRPLANE VIEW OF PIT RIVER No. 1 DEVELOPMENT © AERIAL SURVEYS OF CALIF. S. F.

Vol 16 APRIL 1926 No. 4

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER	JOHN S. DRUM	NORMAN B. LIVERMORE
CHAS. L. BARRETT	F. T. ELSEY	JOHN A. McCANDLESS
W. E. CREED	D. H. FOOTE	C. K. McINTOSH
W. H. CROCKER	A. F. HOCKENBEAMER	JOHN D. McKEE
A. B. C. DOHRMANN	FRANK A. LEACH, JR.	C. O. G. MILLER

OFFICERS

W. E. CREED	*President*
FRANK A. LEACH, JR.	*First Vice-President and General Manager*
A. F. HOCKENBEAMER	*Second Vice-President and Treasurer*
D. H. FOOTE	*Third Vice-President and Secretary*
CHAS. L. BARRETT	*Assistant Secretary*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, JR., Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney	LAW DEPARTMENT
C. P. CUTTEN, Attorney	RATE DEPARTMENT
R. J. CANTRELL, Manager	PROPERTY AND TAX DEPARTMENT
E. W. HODGES, General Auditor	ACCOUNTING DEPARTMENT
H. T. TERRY	CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager	CREDIT AND STOCK SALES DEPARTMENTS
JOHN H. HUNT, Purchasing Agent	PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent	SUPPLY DEPARTMENT
E. G. McCANN, Manager	PERSONNEL DEPARTMENT
	ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT
O. W. PETERSON	Engineer of General Construction
E. H. STEELE	Engineer of Line Construction
F. R. GEORGE	Engineer of Operation
GEO. H. BRAGG	Engineer of Maintenance
	DEPARTMENT OF ENGINEERING
J. P. JOLLYMAN	Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER	Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE	Chief of Division of Civil Engineering
F. M. HARRIS	Chief of Bureau of Specifications and Estimates
O. A. KNOPP	Chief of Bureau of Tests and Inspection
	DEPARTMENT OF EXECUTIVE ENGINEER
F. C. PIATT	Valuation Engineer of Electric Properties
J. T. RYAN	Valuation Engineer of Gas, Water and Railway Properties
B. B. BECKETT	Rate Engineer
S. B. SHAW	Automotive Engineer
W. G. JACK	Manager Land Department
	GAS CONSTRUCTION AND OPERATION DEPARTMENT
FRANK WILLS	Engineer of Production
R. S. FULLER	Engineer of Distribution
HARRY J. SMITH	Engineer of Construction
	PUBLIC RELATIONS AND SALES DEPARTMENT
R. W. ROBINSON	Assistant to Vice-President in Charge of Public Relations and Sales
DON C. RAY	Manager Bureau of Public Relations
N. R. SUTHERLAND	Manager Commercial Department
H. M. CRAWFORD	Sales Manager
R. T. STEPHENS	Manager Electric Sales
FORREST U. NAYLOR	Manager Gas Sales
J. CHARLES JORDAN	Manager Publicity Department

W. B. BOSLEY, General Counsel

JOHN P. COGHLAN, Assistant to the President

F. S. MYRTLE, Editor-in-Chief Pacific Service Magazine

DIVISIONS AND MANAGERS

DIVISION MANAGERS		DISTRICT MANAGERS		HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION			Marysville
		J. V. KYLE	Colusa District	Colusa
I. B. ADAMS	DE SABLA DIVISION			Chico
H. M. COOPER	DRUM DIVISION			Auburn
		L. H HARTSOCK	Nevada District	Nevada City
L. H. NEWBERT	EAST BAY DIVISION			Oakland
		J. H. PAPE	Berkeley District	Berkeley
H. C. ROSS	FRESNO DIVISION			Fresno
H. G. RIDGWAY	NORTH BAY DIVISION			San Rafael
		L. J. PETERSON	Petaluma District	Petaluma
		C. D. CLARK	Napa District	Napa
		C. D. CLARK	Vallejo District	Vallejo
		M. G. HALL	Santa Rosa District	Santa Rosa
E. W. FLORENCE	SACRAMENTO DIVISION			Sacramento
		C. E. SEDGWICK	Solano District	Dixon
		J. W. COONS	Yolo District	Woodland
HENRY BOSTWICK	SAN FRANCISCO DIVISION			San Francisco
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION			Modesto
		W. E. ESKEW	Electra District	Jackson
		C. R. GILL	Modesto District	Modesto
		J. H. FAGG	Stockton District	Stockton
		CHAS. H. NOACK	Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION			San Jose
		W. T. KELLOGG	Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION			Redding
H. B. HERYFORD	WEST SIDE DIVISION			Red Bluff
		STEPHEN GOIN	Willows District	Willows
		CHAS. HUGHES	Red Bluff District	Red Bluff

Pacific Service Magazine

Volume XVI Number 8

Contents for April, 1926

VIEW OF MT. SHASTA FROM NEAR SHASTA CITY - *Frontispiece*

The "Pacific Service" Record for 1925—
PIT THREE COMPLETED, PIT FOUR STARTED - - - 235

TO TRANSMIT "PACIFIC SERVICE" POWER—
HIGH-TENSION SUBSTATION CONSTRUCTION - - - 238

SUBSTATIONS FOR LOCAL DISTRIBUTION—
IMPORTANT WORK IN BAY CITIES - - - - - 244

SCIENTIFIC RESEARCH IN GAS DEPARTMENT—
SOME INTRICATE PROBLEMS INVOLVED - - - - 249

SULPHUR—A NEW BY-PRODUCT TO BE
RECOVERED FROM GAS MANUFACTURE - - - - 252

ADDITIONAL GAS-HOLDER FOR EAST BAY—
TEN MILLION CAPACITY, WATERLESS TYPE - - - 256

THE PUBLIC RELATIONS PROGRAM AND
CREATIVE SALES CAMPAIGN - - - - - - - - 258

HOUSING THE SUPPLY DEPARTMENT—
WAREHOUSE GROUP AT EMERYVILLE - - - - - 261

THE FINANCIAL SIDE OF "PACIFIC SERVICE" - - - - 264

EDITORIAL - - - - - - - - - - - - - 266



(Photo Copyright by Gabriel Moulin, San Francisco, 1926)

View of Mt. Shasta, majestic sentinel guarding the northern portal of the Pit River basin, from the vicinity of Shasta City, formerly called Sisson.

PACIFIC SERVICE MAGAZINE
Volume XVI APRIL, 1926 Number 8

The "Pacific Service" Record for 1925— Pit Three Completed, Pit Four Started

The completion and placing in operation of Pit River No. Three Development, with its installed capacity of 108,580 horsepower, is held to have been the outstanding achievement in the "Pacific Service" record for 1925.

A description of the opening ceremonies, which took place on the afternoon of Saturday, July 18, was given in the July number of PACIFIC SERVICE MAGAZINE. A feature of the occasion was an address by First Vice-President and General Manager Frank A. Leach Jr., in which he congratulated the engineering forces responsible for the construction of the plant upon having done their work within the estimated time and, also, within the estimated cost. The construction work, in fact, was remarkable for the mathematical precision with which the three leading features, namely, the diversion dam, the tunnel and the powerhouse, were carried to completion within a few days of one another, so that all vexatious delays were eliminated from the construction program. It was indeed regarded as an achievement that a power-plant of so great magnitude, involving the construction of a diversion dam 130 feet high and 470 feet long and a concrete-lined tunnel nearly four miles in length, should be carried through to completion in the space of about twenty-five months.

Since its construction Pit No. Three has been doing yeoman service. The engineering department had estimated its probable contribution to the "Pacific Service" power pool at 400,000,000 kilowatt hours a year. It may be said now that the plant has bravely lived up to the predictions made for it, and at the present time is respon-



Diversion dam and tunnel intake at Pit River No. Three Development. The gate-house is seen at the extreme right of the picture.

sible for about twenty per cent of the regular output from our company's comprehensive electric generating system.

Pit No. Three, apart from its service value, is remarkable for unusual and picturesque features of construction. The very diversion dam that stretches across the river is in itself a work of art, surmounted as it is by a highway bridge which when brilliantly lit at night presents a spectacle worth the view. This bridge was built by our company, with the full consent of the Board of Supervisors of Shasta County, as part of a new highway route between the towns of Burney and Bartle. Previous to that travelers along that route crossed the Pit river at Peck's bridge, but that time-honored wooden structure now lies fifty feet below the surface of Lake Britton, by which name the forebay reservoir created by impounding the waters of the Pit at the diversion dam is now officially known. This reservoir occupies a flooded area of about 1300 acres in surface extent and is nine miles in length, for it backs the waters of the Pit to the point called Warner bridge, within hailing distance of Pit River No. One Development that was the first major plant of the Pit River System.

Returning to the highway, the new section constructed by our company's engineers leaves the old road at a point about twelve miles from Burney and traversing a three and one-half mile stretch of country to the river crosses the bridge over the diversion dam and then winds its way over another three and one-half mile stretch to Cayton valley. The new highway has been in constant use since the opening of the power-plant and is much favored by sightseers in that section of the country.

Other changes have taken place in the surrounding landscape. The headquarters camp at Pit Three, which was generally regarded a model of camp construction, no longer exists. A few small wooden buildings are now all that is left of a busy community that harbored 1400 souls. The greater part of the men are gone, some down to Pit No. Four, some to our construction work at Melones, and some to the Mokelumne river, while there are left about 250 engaged in repairing and shipping equipment and assisting in the preliminary work on Pit No. Four Development. The only official left in that vicinity now is the gate-keeper at the intake, who dwells in a cottage built for him at the hillside



Lake Britton, forebay reservoir at Pit River No. Three Development. It is 9 miles long, covers a surface area of 1,300 acres and is of 30,000 acre feet capacity.

beneath the site of the once busy headquarters camp. There is a community center now at Pit No. Three, below the power-house, where clubhouse, dormitory and six cottages are in daily occupation. Here is now the headquarters of the development.

Before the year 1925 closed some preliminary work had been done upon the development next in order, Pit No. Four. A site for the diversion dam had been located at a point about two miles down stream from Pit No. Three power-house, work begun upon a temporary diversion dam to be constructed for the purpose of emptying the riverbed at the permanent dam site, some excavating done upon abutments for the permanent dam and a start made in boring the upper end of the four-mile tunnel; while the Pit river railroad had been extended three miles down stream to the site of the new development and a new construction camp set up.

Since the beginning of the year 1926 and up to the present time the work has been carried on, and it is confidently expected that by the end of the first half of May the temporary diversion dam will have been completed and the waters diverted so as to allow pouring the foundation of the permanent dam.

The dam will rise 60 feet above the surface of the stream and will have a total length of 430 feet. The reservoir created by the raising of the waters will be of 2,000 acre-feet capacity and will serve as an afterbay for Pit No. Three as well as a forebay for Pit No. Four.

The entrance to the tunnel will be located 100 feet upstream from the permanent dam. The tunnel will be 23,782 feet in length, 19 feet in diameter and of 3,000 second feet capacity. From the lower portal of the tunnel three penstocks 129 inches in diameter and about 1,100 feet in length will utilize a head of 377 feet to deliver water to the power-house, where the equipment will consist of three 40,000 horsepower turbines connected to 33,333 K. V. A. generators. The installation, therefore, will be, in round numbers, of 133,000 horsepower capacity. The plant will have the advantage of a slightly higher head than that at Pit No. Three.



Pit River No. Three power-house. Installed capacity 108,580 horsepower.

To Transmit "Pacific Service" Power— High-tension Substation Construction.

Readers of PACIFIC SERVICE MAGAZINE have been advised, from time to time, of important additions to our company's electric service facilities, and it is a matter of common knowledge that the record for 1925 includes the completion of Pit No. Three power-plant, with its installed capacity of 108,580 horsepower. What the public, as a general thing, may not be sufficiently instructed to visualize is the work of reconstruction and reinforcement of the power company's transmission and distribution facilities that necessarily follows when so large a quantity of additional power is made available to the system for distribution to the consumer.

Between the point of generation and the point of consumption lie a number of important links in the service chain. The transmission lines that carry the power from the generating plant in the mountains to various high-tension distributing stations at strategic points; the lines that carry power from these points at a reduced voltage to local substations for local distribution; the substations themselves which bear the burden of insuring adequate service to the local consumer; all play a most important part in the service scheme. It may be said, therefore, that while the hydro-electric generating plants in the far-away mountain regions, together with the majestic steel tower lines traversing the long valleys that lie between the mountains and the centers of industry, command the greater amount of popular attention because of their peculiarly spectacular interest, the distributing substations and the net-work of local distribution lines are in all respects of equal importance in the delivery of electric energy.

As a matter of fact, were it not for the operation of the substations in stepping down the transmission voltage of the electric current to a rating suitable for local distribution, the great hydro-electric systems of the power companies, with their long distance high-tension transmission of hydro-electric energy, would be a practical impossibility. Electric power would be available only within a short radius of the generating station, and the bulk of the energy required to meet popular demand would be derived from small local steam-electric plants at, probably, considerable increase in rates. Thus would, in effect, the clock be turned back to the earliest days of the electrical industry.

It follows, then, that these important factors of up-to-date service call for constant attention on the part of the power company's engineering forces. There is a constantly growing demand for electric power everywhere, and so far as the Pacific Gas and Electric Company is concerned it has been estimated that the load supplied by "Pacific Service" increases at the rate of about seven and one-half per cent each year; that is to say, for every one hundred kilowatt hours transmitted and delivered during one year there are one hundred and seven and one-half transmitted and de-



Birdseye view of Shasta Substation, near the town of Cottonwood.

livered in the year following. To keep abreast of this ever increasing demand for power requires constant attention to the generating and transmission facilities of the power company.

The year of 1925 was an unusually busy one in this respect, for reasons already stated. Several important additions to the company's power distributing system were made, notably in the construction of new substations, both high-tension and local. It might be interesting to our readers to consider these features of engineering construction work, beginning at the point nearest the source of supply and traveling down country to the bay of San Francisco where the high-voltage lines end their cross-country journey and the bulk of "Pacific Service" electric energy is distributed.

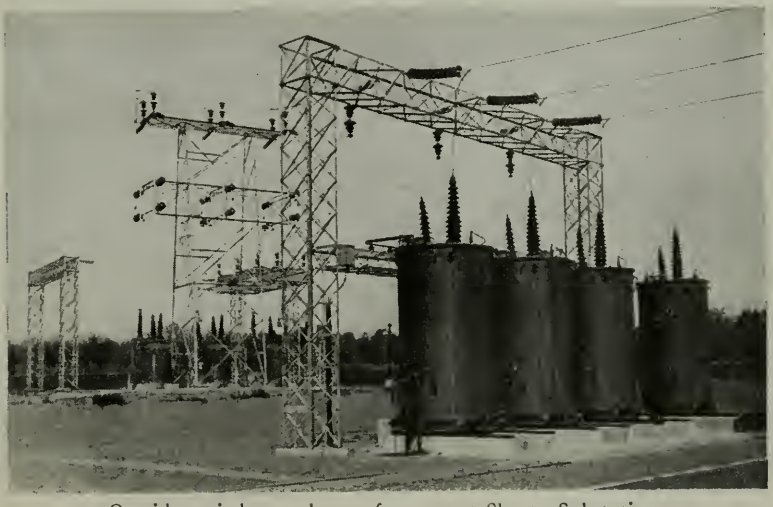
Shasta Substation—Pit River Power House No. 3 added almost eighteen per cent to the installed generating capacity of the system when it went into regular service in July, 1925. The power generated on the Pit River is all transmitted to the load centers around San Francisco Bay over the 220,000 volt transmission lines. In addition to the power generated by the plants of the Pit Development, these lines also transmit power generated at Copco Power House No. 2 and purchased from the California-Oregon Power Company. To take care of this purchased power and raise the voltage to 220,000 for transmission over the lines covering the 200-mile stretch of country between the Pit river and the company's high-tension distributing station called Vaca-Dixon, there was constructed in 1925 Shasta Substation.

Shasta Substation is located about two miles from Cottonwood in Shasta County, at the point on the Pit-Vaca transmission lines where the construction changes from two single-circuit tower lines, with conductors arranged in a horizontal plane, to double?circuit towers with the conductors in a vertical plane. Power from the California-Oregon Power Company's Copco Power House No. 2 is received over a 110,000 volt transmission line approximately 120 miles in length, carried on wood pole structures. The upper 78 miles from Copco No. 2 to Delta was built by the California-Oregon Power Company, and the balance from Delta to Shasta Substation was constructed by "Pacific Service."

It is of interest to note the distance this power is transmitted from its point of generation at Copco No. 2 to the load centers at Oakland and San Francisco. From Copco No. 2 to Shasta is approximately 120 miles. The distance over the 220,000 volt lines from Shasta to Vaca-Dixon is 142 miles and from Vaca-Dixon to Claremont Substation in Oakland over the 110,000 volt lines, approximately 47 miles,—a total of 309 miles.

Some of this power is also distributed in San Francisco through Martin Substation over the 70 miles of 110,000 volt lines from Claremont to Martin via Newark, making a total transmission distance from Copco No. 2 to Martin Station of 380 miles.

The present electrical installation at Shasta Substation is of the simplest possible character. There is a single oil circuit breaker and the necessary metering equipment on the incoming 110,000 volt line from Copco No. 2. The line then



Outside switches and transformers at Shasta Substation.

goes to the main transformer bank, consisting of four 13,333 K. V. A. transformers (one unit is a spare) where the voltage is raised to 220,000.

From the high voltage side of the transformers the line goes to two 220,000 volt oil circuit breakers through which it may be switched on to either of the Pit-Vaca lines. All of the 110,000 and 220,000 volt switch and bus structures are of the standard type developed by the company and used elsewhere on the system.

At present, the substation building is of somewhat odd proportions, but its design may be better understood if some of the factors entering the problem are mentioned. Its only function now is to house the main switchboard, transformer cooling water circulating pumps and other auxiliary station equipment, and to provide facilities for handling a main transformer unit in case repairs are necessary. The great height of the building is occasioned by the fact that the main transformers are 26 feet 8 inches high, about equal to the height of a two-story residence, and the crane which is necessary for lifting the core out of the tank must be high enough to accommodate this extreme size.

The future possibilities of this station were also an important factor in the design of the plant. It is laid out to permit expansion in practically any direction. The building, which is a steel frame reinforced concrete structure, has one temporary end to permit extension for the housing of synchronous condensers. These are at present unnecessary, but it is entirely within the realm of possibility that the future may see a 220,000 volt trunk line extending north into Oregon and Washington. In this event, Shasta Substation will become an important switching junction and will have a large synchronous condenser installation to care for voltage regulation on the 220,000 volt lines. For this reason the present installation was made extremely flexible and all construction was made with the idea of future extension with the minimum disturbance to existing equipment.

Following the 220,000 volt transmission lines along their route from Shasta Substation to their present southern terminus, we arrive at *Vaca-Dixon Substation,* situated about half way between Vacaville and Dixon. This station went into service in 1922 to receive the power generated by Pit River Power House No. 1. The completion of Pit River Power House No. 3 and the contract to purchase power from the California-Oregon Power Company required the enlargement of Vaca-Dixon Substation to enable it to care for this additional power. This extension had been anticipated in the original design and construction of the station and the additional apparatus was installed without interruption to the existing plant.

The equipment added to the station consists of one 50,000 K. V. A. transformer bank to reduce the voltage from 220,000 to 110,000 and to furnish additional current



Exterior of substation building at Vaca-Dixon. Lower portion at left is recent extension.

at 11,000 volts for the operation of synchronous condensers. This represents a fifty per cent increase in transformer capacity. There was also added one 40,000 K. V. A. synchronous condenser for voltage regulation of the 220,000 volt lines. This is the largest synchronous condenser yet built. The new apparatus required additional oil circuit breakers and other facilities for its control, all of which has been added and is now in operation.

From Vaca-Dixon Substation power is sent out at 110,000 volts to Cordelia Substation, Claremont Substation in Oakland, and Contra Costa Substation near Antioch. Claremont Substation has already been described to readers of PACIFIC SERVICE MAGAZINE.

Contra Costa Substation—Contra Costa Substation, located about two miles east of Antioch, is the most recent substation to be constructed on the 220,000 volt transmission system of the Pacific Gas and Electric Company. Readers of PACIFIC SERVICE MAGAZINE for January will recall a description of the new transmission line from Vaca-Dixon Substation to Antioch, with particular reference to the high towers being constructed where the lines cross the Sacramento and San Joaquin Rivers.

The new substation is the southern terminus of this line and will serve a very important purpose by affording an outlet for power generated on the Pit River into the district in the vicinity of Antioch and Pittsburg and extending on around the southern shore of upper San Francisco Bay.

One has but to drive through this district to be impressed with its very rapid growth. Industrial plants of large size are being built on all sides, notable among them being the Columbia Steel Company and Redwood Manufacturing Company at Pittsburg, the General Chemical Company at Nichols and the Associated Oil Company at Avon. These plants, with their associated residential developments, have caused a very substantial increase in the demand for power throughout the entire area, and it is to afford a means of supplying this demand that Contra Costa Substation has been constructed.

The substation building is a steel frame reinforced concrete structure of very pleasing appearance. In anticipation of the continued growth of power demand to be supplied from this station, it has been designed to permit of extension to more than twice its present size. One end is of a temporary nature, being constructed of hollow tile which can be removed readily when the time comes for expansion, and all design work has been carried out with the idea of permitting additions from time to time without disturbing the present equipment.

The equipment now installed in the building consists of one 15,000 K. V. A. synchronous condenser, whose purpose is to stabilize the voltage and afford power factor correction, and the main switchboard



Interior of Vaca-Dixon Substation, the new 40,000 K. V. A. synchronous condenser in the foreground.



Contra Costa Substation. Exterior of the station building.

for the control of all apparatus either in the building or elsewhere on the substation site. The building also houses such auxiliary apparatus as storage batteries for the operation of oil switches, pumps for the circulation of cooling water through the main transformers, an electric crane for the untanking and repair of a transformer should one become damaged, and other equipment of a minor nature necessary to the convenient operation of the station.

The property on which the substation is erected comprises approximately sixty acres. The building occupies but a small portion of this area, but the balance is necessary for the outdoor switch and bus structures. The lines entering from Vaca-Dixon Substation will operate for the present at 110,000 volts, but are built for operation at 220,000 volts when the 220,000 volt transmission system is extended on south to a terminal substation in the general vicinity of Newark.

Such a voltage requires a wide separation between the wires comprising the three phases, and, consequently, a large station area is essential to accommodate the line switching equipment.

The incoming lines from Vaca supply a bank of three 10,000 K. V. A. transformers, with a fourth transformer held in reserve as a spare, and the voltage is reduced to 60,000 and 11,000. The 60,000 volt side



Contra Costa Substation, recently constructed, near the city of Antioch.

of the transformers feeds the main 60,000 volt bus structure from which lines radiate to Herdlyn Substation, South Tower Substation and Columbia Steel Substation. The 11,000 volt supply from the transformer bank is for the sole purpose of operating the synchronous condenser for voltage and power factor control.

As was the case in the substation building itself, the bus structures and other apparatus in the yard have been laid out for very convenient extension. The problem of forecasting future development or growth is a difficult one, and it has invariably proven the case that the most optimistic provisions for the future have proven inadequate in a very few years. Contra Costa Substation has been so designed that it can readily accommodate any demands which the future may require of it, and while at present the station is small in point of installed electrical capacity when compared with Vaca-Dixon or Newark Substations, the future will undoubtedly see it increasing in importance as a center of load distribution for a very large industrial center.

Martin Substation—Martin is unlike Shasta and Contra Costa Substations in that it has long been associated with the distribution of power by the Pacific Gas and Electric Company. The original station, built in 1905, was named after John Martin, well known as a pioneer of high-voltage transmission of electric power in California. The new Martin Substation is located on a large piece of company property south of San Francisco and is a short distance from the old station.

The present station forms the nucleus of an ultimate plant of large capacity for receiving hydro-electric power at 100,000 volts and transforming to 60,000 volts for use on the peninsula territory to the south, and also to deliver power at 11,000 volts to the distribution stations in San Francisco. Furthermore, at this station is effected the principal inter-connection between the Pacific Gas and Electric Company and the leased Sierra and San Francisco Power Company.

The substation building is constructed of reinforced concrete, with steel framing, and the outside walls of the building are plastered the usual buff color. Many large windows insure a well lighted interior.

The large number of 11,000 volt power lines require many switches for controlling and operating the lines, and this switch equipment occupies a large portion of the building.

The outdoor arrangement of the station is such that additional lines and transformers may be added as power requirements demand.

The foregoing description of two completely new major transmission substations and extensive enlargement of two other substations is indicative of the growth of "Pacific Service" and the great demands for power made upon it. In excess of $2,500,000 was expended upon these four stations during the past year.



Martin Substation, on the bay shore south of San Francisco. The old building constructed in 1905 is seen in the background.

Substations for Local Distribution— Important Work in Bay Counties

Substations and the circuits leading from them are more responsive to growth of demand and variations in the type of load than any other part in a power system. If a residential district exhibits building activity the adequacy of the substation serving that territory must be reviewed at once. Should an industrial growth develop in what was formerly a residential section, the load assumes different characteristics, which must be cared for in the substation. Even in this day of automobiles the establishment of new homes or new factories requires increased street railway facilities. In other words, while the generating plants reflect the average load conditions obtaining throughout a territory of considerable extent, the substation relates strictly to the localized conditions of the district which it serves.

The year 1925 was distinguished by unusual activity in local substation construction, especially in the Bay region, where the tremendous growth in population and industrial expansion brought about a marked increase in demand for all classes of service. San Francisco Division experienced an 8.47 per cent increase during the year, while the East Bay Division showed an increase of 7.42 per cent in demand for power. All of this had to be adequately provided for, not only as the demand presented itself, but, also, in advance. Substations and their distribution circuits cannot be erected overnight.

Since the distribution system of an extensive area, such as the Bay region, must be constructed piece-meal, as the need arises, and since these piece-meal parts must build together into a closely coordinated system in the course of several years, it follows that a consistent plan must be evolved at the beginning. The work prosecuted on the Bay region substations during 1925 was in conformity with such a construction scheme.

Taking, first, San Francisco, two new substations were constructed and a considerable volume of additions and betterments completed.

New Station "J", on Commercial Street, between Montgomery and Sansome, is the distribution center for a rapidly expanding commercial district in the Western metropolis. The old Station "J" was so heavily over-loaded in 1924 as to require the prompt construction of the first portion of the new station during the fall and winter of that year. The second portion consisting of additional building work and certain equipment, was undertaken in 1925.

Owing to the comparatively small dimensions of the site the design of this station is different, in many respects, from any other on the system, in that the building is carried up vertically in lieu of extending horizontally. The first installation consisted of three 9,000-ampere converters, double the capacity of the old station, with room for the ultimate installa-



New Substation "J", on Commercial street, San Francisco.

tion of six such machines. These serve twenty-two 1,000-ampere feeders. To those who are not acquainted with electrical terms a synchronous converter is merely a machine which receives alternating current from the outside transmission system or generating station, as the case may be, and after converting it to direct current sends it out as such for general commercial use. There is also one 1,000-kilowatt synchronous converter delivering current at 600 volts for the street railways.



Station "L", on. Ocean avenue, near Junipero Serra Boulevard, San Francisco.

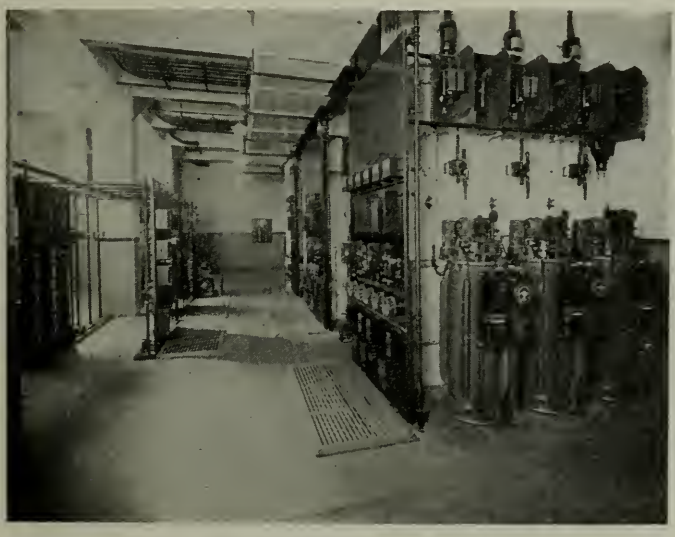
There are also several 4,000-volt alternating current feeders leading from this station for general lighting and street lighting service.

The power supply to this station is received at 11,000 volts from three sources, the North Beach steam-electric plant, Station "A" steam-electric plant at the Potrero, and hydro-electric energy through Martin Substation, South San Francisco. This insures an unfailing supply of power to this most important station.

Station "L", on Ocean Avenue, near Junipero Serra Boulevard, is also somewhat unique, in that it is solely under remote control and no operator is in attendance except for occasional inspection. It is rather startling to one unacquainted with recent substation practice to learn that an investment amounting to $200,000 in electrical equipment can be so designed as to be operated automatically, or by supervisory control from a distant point.

Station "L" is the center of a rapidly developing residential area to which it distributes power for general use. Provision was made in the plan to permit of the installation of railway equipment at this point in the future, should the need arise.

Other very important work was completed during the year in connection with added equipment in practically every substation in San Francisco. Some of this was associated with the program of cutting over the old 2-phase system progressively to a 3-phase system. At Station "I", situated in the Mission district, a large converter and a motor-generator set were erected, the switchboard entirely rebuilt, and regulator equipment installed.



Interior of Station "L", San Francisco, showing modern style of automatic substation equipment.

The distribution substations serving a growing community like San Francisco are the centers of continuous activity and only by forethought and careful planning can the

facilities be effectively kept abreast of the rapidly expanding demand. A similar situation is found in East Bay Division, embracing Alameda and Contra Costa counties. For this area another program has been developed entirely independent of San Francisco, except as it is related to the general transmission and generating system of the Company as a whole.

Station "J", Oakland, located on Fiftieth Avenue, near Clark Street, is in reality a high-tension station, in that it receives current at 110,000 volts from the transmission network and steps it down for 11,000- and 4,000-volt distribution. This was undertaken as one of the steps in the progressive plan for handling effectively the 110,000-volt system between the Vaca-Dixon Substation near Vacaville and the Newark Substation. Station "J" serves East Oakland in the same capacity as the Claremont Substation serves North Oakland and Berkeley with hydro-electric power.

Construction was started in 1923 with the erection of the building and the installation of certain low-voltage equipment relieving Station "H" at Twenty-third Avenue of a portion of its local distribution load. The high tension work was postponed until a year later, when the load in that territory had increased sufficiently to warrant it. The station was finally fully equipped and placed in operation during May of last year.

Still further out from the center of Oakland is the new Station "I", at Ninetieth Avenue, near East Fourteenth Street. This new station is to replace old Station "I" at Elmhurst, adjacent to the Key System car barns, which is then to be dismantled. The old station is of considerable interest historically, much of the equipment having been there many years before the organization of the present Pacific Gas and Electric Company. This station receives its power from Station "J", and in turn distributes it throughout the rapidly expanding industrial territory about Elmhurst and Hayward. Motor-generator capacity amounting to 2,400 kilowatts has been installed there for the street railways, as well as certain 4,000-volt circuits for local distribution in the immediate vicinity. Allowance also was made for the future installation of additional 11,000- and 4,000-volt equipment when needed.

Architecturally the design is simple and in keeping with the general industrial character of the district in which it stands.

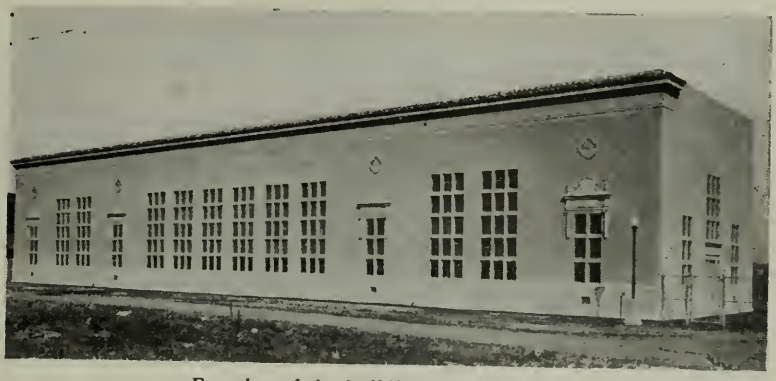
Station "O" at East Fourteenth Street and Llewellyn Road, now under construction, will feed out of Station "I", distributing in the vicinity of Hayward, and in addition carrying considerable street railway load.

Station "D", situated at Shattuck Avenue and Fifty-first Street, Oakland, which was placed in service in August, 1925, was one of the outstanding installations in the



Station "J", Oakland, a high-tension substation, which stands to East Oakland and environs in similar relation to that occupied by Claremont Substation toward North Oakland and Berkeley.

East Bay Division. The load supplied by this station had been increasing at so rapid a rate as to make reconstruction and expansion necessary.



Exterior of the building at Station "J".

An old station has been in operation there for a number of years, and while it had served faithfully and well, had, nevertheless become obsolete through the rapid advances of substation practice during the past decade. It was therefore decided to construct an entirely new station.

This station is largely for the purpose of furnishing direct current to the Key System for the operation of its street cars. Only alternating current can be transmitted economically over any considerable distance; on the other hand street railway motors require direct current. These conditions were met by the installation of three 1,000-kilowatt rotary converters, which receive the incoming alternating current and, after conversion, send it out to the railway feeders as 600-volt direct current.

In addition to its converter equipment, this station supplies several 4,000-volt feeders serving a considerable residential and commercial demand in that territory. It is also the switching center for the 11,000-volt circuits entering Oakland from Claremont Substation on the shore of Little Lake Chabot, which is in turn tied into the company's high-tension network into which the huge hydro-electric and steam-electric plants feed.

An entirely different situation obtained with reference to Station "L", situated on Twentieth Street between San Pablo and Telegraph Avenues. No station had existed here, this territory having been served from Station "A" at the foot of Grove Street. Not only had the area within reach of the new station increased greatly in demand, but the same was true of the whole of down-town Oakland, all of which was served from Station "A". In that vicinity was the greatest activity in flood lighting and electric signs, not to mention the growing appreciation of the value of higher intensities of store lighting. It was obvious that the only solution lay in taking a portion of the district away from Station "A", and serving it from new Substation "L". In addition to the growth of domestic and commercial requirements there was also an increase in the Key System demand which had been carried from old Station "E" at Oakland Avenue and Twenty-fourth Street.

New Station "L" was accordingly designed to include three 1,500-kilowatt rotary-converters of the character described above. These took over a portion of the load from old Station "E", the remainder being assumed by new Station "E" which was undertaken at about the same time.



Station "F", Berkeley.

Externally, Station "L" is an attractive building with plastered walls of a warm cream color, topped with red Spanish tile. A considerable court area in grass with an iron property fence offers a pleasing

approach from Hobart Street. The completed structure represents an expenditure in excess of $700,000 in building, equipment and land.

The new Station "E", on Linda Avenue, near Oakland Avenue, in Piedmont, is somewhat simpler electrically than Station "L". Due to its location in a high value residential district, unusual consideration was given to the architectural design and the planting of the lawn and shrubs. In order to carry the remainder of the street railway load from old Station "E", two 1,000-kilowatt motor-generator sets were installed. With Station "L" and new Station "E" in operation, old Station "E", with its obsolete equipment, was discontinued.



Substation "L", on Twentieth and Hobart streets in the heart of the city of Oakland. View taken from the Hobart street side.

In addition to the railway equipment, space was provided for the erection, later in the year, of the necessary transformers and switches for certain 4,000-volt distribution feeders which will then be required by the increased lighting load in that territory. All preliminary work in the way of foundations, and ducts has been done in advance, so that it will be a simple matter to set this future equipment in place and make the necessary connections.

Additional substation work of miscellaneous character was done under cover, as it were, within the existing stations. This embraced the installation of some new transformers at Station "F", Berkeley, a new 1,000-kilowatt motor-generator set at Station "H", Twenty-third Avenue, Oakland, and a considerable volume of scattered improvements and expansions.

This is the story of the substation program as carried out for the year 1925. The lay reader, to whom transformers, converters and switches are merely electrical terms, will undoubtedly be most impressed by the costs of substation construction. Heretofore he has not realized perhaps that a simple concrete building costing a few thousand dollars could contain electrical equipment mounting into the hundreds of thousands of dollars.

One new consumer signing an application for electric service does not present much of a problem, but when he comes by the thousands as he has in the San Francisco and East Bay divisions and brings with him industrial loads and a demand for increased transportation, it is another affair. During the past year our company expended approximately $4,000,000 upon substation construction in San Francisco and East Bay divisions, this sum exclusive of expenditures for local distribution lines.



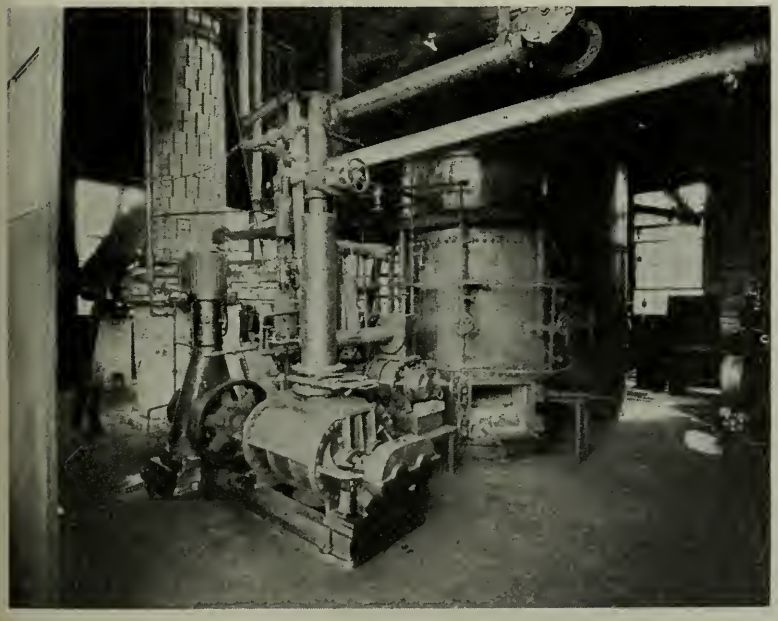
Substation "E", Piedmont.

Scientific Research in Gas Department— Some Intricate Problems Involved

Scientific research has become an important activity in the Gas Department and the results of these efforts are as worthy of attention as are the building of the physical structures which serve the public more or less mechanically. Every improvement in method and each discovery which makes possible the use of a new material or which makes an old one more useful has a more lasting influence than the edifice which is built of brick or stone.

The gas industry is developing faster than at any time in its history. Based upon complicated principles of physics, chemistry, thermo-dynamics and engineering, it offers a great field for study and experimentation. The scientific world is now supplying more fundamental laws applicable to industrial processes than ever before. As a result, specialists devoted to the study of special problems and the application of new knowledge to the present operations have become a permanent part of the progressive gas organization.

The gas research is conducted along two lines. Our own company, for instance, participates in the work of the California Gas Research Council, which is composed of representatives of the gas companies in California that have united for the solution of those problems which are of general importance; this provides for free interchange of ideas and eliminates duplication by the assignment of certain work to each company. Then, in addition to the problems assigned to the company by the Council there are other matters that are more specific and of less general application to which the company's available research facilities in laboratories and men, are applied. The "Pacific Service" personnel is well trained and the equipment is quite complete. Specialists are consulted freely and, occasionally, experts in certain lines are secured to direct and advise; but the details are worked out by the regular employees. The general scheme of operation, the adequacy of the apparatus and the results obtained therefrom are unusual and have brought forth favorable comment from those who are experienced in such matters.



Gas-making apparatus at the Pacific Gas and Electric Company's North Beach plant, San Francisco, devoted entirely to gas research and experimental work.

The fruits of this kind of activity are both large and small, but it is only the larger that attract attention. During the

past year many useful suggestions and improvements were introduced but because of their lesser importance only a few of these are given here.

A continuous oil-gas process was developed in which the carbon residue is consumed within the generators. The fundamental principles of naphthalene removal, including improvements in the design of scrubbers, were carried to further perfection. Waste benzol liquors from the drips on the transmission mains are now being refined into a good saleable product. A simple method for the partial dehydration of the lampblack by-product of gas manufacture which will make it much more useful has been found; as yet, however, the practical application of this has not been perfected. An improved process for the recovery and utilization of the sulphur obtained in purifying manufactured gas was completed. This research was unique and is reported upon in a separate article.



Chemical laboratory for gas research work installed at the North Beach plant.

The most important problem yet undertaken, however, is the future supply of gas-making materials. A study of the petroleum situation made upon data from all accessible sources establishes a belief that the price of oil will, within a few years, be so high as to prohibit the use of processes that depend entirely upon oil. The gas-making method now used by this company depends entirely upon residuum from the oil refineries. It is, therefore, quite desirable that the gas be made of coal and, if possible, from coal in California. But, these coals are not of the character commonly classed as gas coals. Thus, the solution of this problem involves a number of studies: An economic study of coals available to Central California from all sources; examination of these coals as to their adaptability to present known gas-making processes; possibilities of adapting or modifying present gas-making methods to the use of local coals; development, if necessary, of a process for utilizing local coals.



Exterior of experimental gas manufacturing plant.

Two of these studies have been completed and

a plan of procedure has been adopted, but the final solution will depend upon the developments as the experiments proceed.

Of the gas-making coals available to Central California there are three sources that fall within the class of economic possibility, namely, Utah, Australia and Washington. All of these are from without the State. Some of the coals in California would be good for gas-making were it not for their high sulphur content, while all of the local coals having a low percentage of sulphur are poor in gas-making qualities according to the ordinary methods of determination. There is, however, a deposit of sub-bituminous coal in the northern part of the State which is low in sulphur and is accessible to our territory. The logical procedure is to attempt to adapt some of the present manufacturing processes to this material.

The process of gas manufacture chosen for this purpose is that of carburetted water-gas with the back run feature. This latter makes it possible to obtain efficiencies with low grade bituminous non-coking coals comparable with those formerly obtained with a good grade of coke or anthracite coal. A further improvement in the old carburetted water-gas process is the addition of a flash-type boiler which generates the steam required for gas making by utilizing waste heat. The flash boiler with the back run feature adds a certain amount of super heat to the steam which assists in the utilization of low grade fuel by increasing the speed of the reaction, thus overcoming the retarding effect of high ash or low combustibility. Test runs upon a commercial sized experimental unit indicate that this process will operate satisfactorily upon the sub-bituminous coal nearest at hand.

Comparison between the gas-making coals from without the State and available to this territory at a fair price with coals now being used successfully in other parts of the country by this apparatus leaves no doubt that, at present prices, carburetted water-gas can compete economically with the present oil-gas plant, especially in those communities where the daily sendout is less than two million cubic feet per day.

Plans are being drawn for the conversion of our company's plant at Marysville from oil-gas to carburetted water-gas, and the necessary construction work will be completed within five or six months. This is the first step in California toward supplanting the oil-gas method of gas manufacture with one using coal. The Marysville location is adaptable to the use of either gas-making coals or sub-bituminous coal and, should the latter prove successful, it will be the first instance in which that has been accomplished. In either case, the dependence upon oil as a gas-making material will be substantially reduced and may eventually be eliminated.

Thus the Research activity of the Gas Department shows a successful year. With notable accomplishments actually completed and future achievements practically assured, it has assumed considerable importance but the most remarkable feature is that this has been done without personal glorification. The excellent spirit of the entire organization where help and constructive suggestions were given and accepted willingly and freely, has built a smooth running procedure through which the problems are handled without friction or loss in time. To everyone who has participated in this work there has been given a source of satisfaction in that they have each contributed to its success.



Section of laboratory assigned exclusively to coal tests.

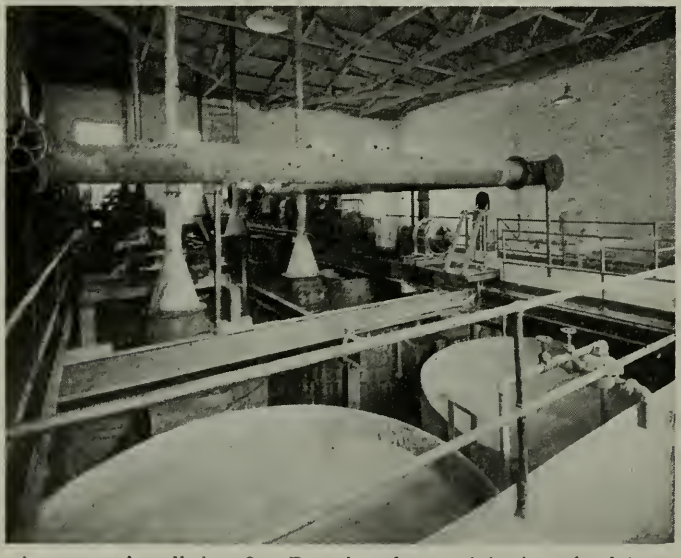
Sulphur—A New By-Product To Be Recovered from Gas Manufacture

A new process for the removal of sulphur compounds from manufactured gas was perfected and placed in operation by the Pacific Gas and Electric Company during 1925. This is of importance for the reason that it is the first instance in which the sulphur removed from manufactured gas has been recovered as a marketable by-product. The process can and, doubtless, will be adopted in all the larger gas plants of this Company's system.

The form of sulphur produced is more efficient in insect control and will probably be a more active fertilizer than any form of sulphur yet produced upon a commercial scale. This innovation in the gas industry is, therefore, of vital importance to the agriculturist and may finally prove to be of general value to the public by making the gasification of high sulphur fuels profitable.

The story of this achievement is instructive because, from a technical standpoint, another step forward has been made, and because its accomplishment has been a succession of triumphs over obstacles varying widely in character and involving principles drawn from the results of the most recent researches. The presence of sulphur in the crude manufactured gas is due to the sulphur compounds in the oil or coal from which it is made. Although limitations as to their percentage are placed upon the producers it is impossible to obtain materials that are entirely free from them. The gradual exhaustion of the supplies of the high grades of both oil and coal makes it more and more difficult to obtain fuels of a standard purity. The gas companies, therefore, do not see their way to abandon their gas purifying apparatus but must plan to improve them and increase their capacity. Any marked improvement is of great importance as it will make available to the industry cheaper fuels which it has not been able, so far, to use.

The first method of purifying manufactured gas consisted in passing the gas through layers of slacked lime. After this lime became saturated with sulphur it was replaced with a fresh supply. The spent lime was a very disagreeable waste. Its disposal was difficult and increased the cost of operation which was otherwise already quite high due to the fact that large quantities of fresh lime were required. This method was later replaced by using iron oxide. The iron rust was prepared artificially by various means and deposited upon the surface of shavings. This gave a porous mass through which the gas was easily passed. The iron oxide absorbed the sulphur from the gas. This material was much better than the lime because by exposure to air it could be revived and used again many times before discarding, and its disposal was less troublesome. The iron oxide method is still in almost general use.

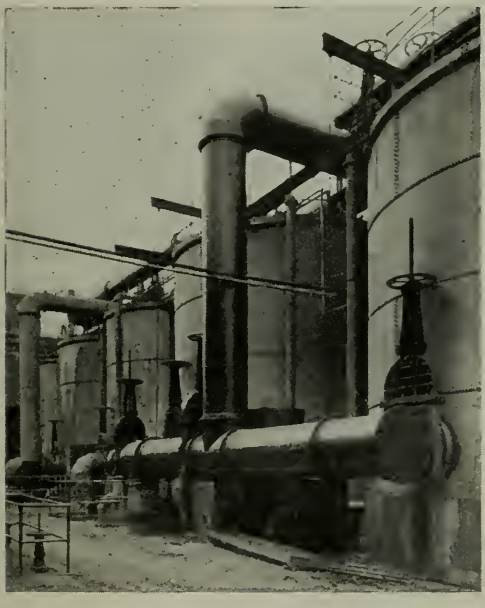


Apparatus installed at San Francisco for precipitation of sulphur.



A few hundred tons of precipitated sulphur paste—Potrero Gas Plant, San Francisco.

In 1921 there was introduced a process in which a soda ash solution was used for scrubbing gas and the solution was revived by spraying it into a scrubbing tower through which air was blown. There were two distinct advantages in the soda ash method. The apparatus required occupied much less ground area for a given capacity than did the iron oxide method and the cost of operating was lower. There was, however, a very serious objection to this process. When the soda solution was revived in the scrubbing tower through which air was blown, a foul smelling gas was occasionally released at the stack. The Pacific Gas and Electric Company adopted this process, however, believing that through scientific means it would be found possible to eliminate this disagreeable feature. Two methods were proposed, one consisting of dilution with large volumes of air, the second the burning of the hydrogen sulphide. These, however, were not entirely satisfactory, for while eliminating the odor they still permitted the sulphur compounds to be discharged into the atmosphere.



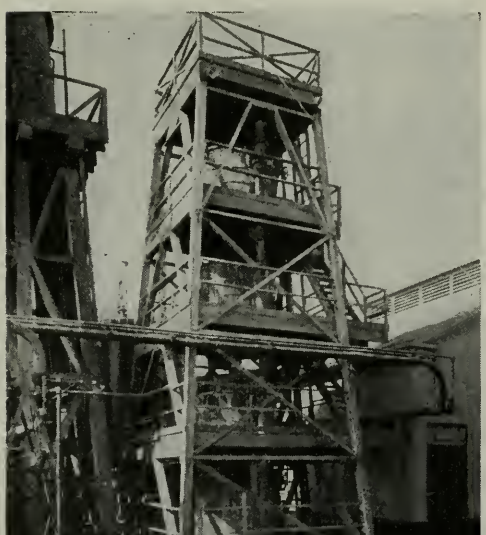
Absorbing towers for scrubbing the hydrogen sulphide from the gas—San Francisco plant.

Further improvement of the process was undertaken. Research chemists were consulted and employed. A definite line of procedure was adopted and laboratory work begun. During the research work a chemist, while making a certain experiment, omitted one of the ingredients and thereby accidentally discovered a short cut in the process. Further laboratory tests proved the method by which the sulphur could be recovered. But, the reaction was slow and incomplete. During the study of the rate of reaction, another chemist found that by stirring the solution with an egg-beater the reaction could be carried to completion in a few minutes. This led the study into the development of an apparatus for accomplishing the same chemical results upon a more extensive scale and, at the same time, sufficiently economical in power consumption.

Three different types of apparatus were selected and installed severally in the gas manufacturing plants in Oakland, San Francisco and San Jose, where after operating difficulties had been adjusted there was accomplished the production of a precipitated sulphur which was filtered from the

solution and delivered to bins in a paste form containing about fifty per cent water. Examination was made of the physical and chemical characteristics of this paste, in order to find out whether it possessed any commercial value and by what means it could be prepared for market. This investigation is not yet concluded, but the results already obtained are sufficiently conclusive to allow of certain deductions.

This sulphur, for instance, has proven to have certain characteristics which make it especially valuable as an insecticide. Being a precipitated sulphur it is of very fine structure, so fine that it is almost collodial. It seems to carry with it certain impurities which really are of advantage. Once dried it seems to be readily wettable, and when used either wet or dry adheres to surfaces tenaciously, and for that reason is highly efficient for the purpose indicated. A fine sulphur that may be dusted or readily held in liquid suspension has been sought by the sulphur industry. The agriculturist has for some years used sulphur for an insecticide but has had difficulty in finding a form of sulphur which would give satisfactory results for eliminating the red spider and controlling mildew, especially in the early spring when the temperature is still somewhat low. It is believed that a finely divided sulphur, if produced cheaply enough, would serve this purpose. Experiments conducted at the University of California and in the field indicate that sulphur precipitated from gas manufacture is adaptable to and does satisfy that purpose.



Apparatus installed at the San Jose plant for the precipitation of sulphur from the purifying solution.



Absorbing towers at the San Jose works.

The agriculturist may also use sulphur for fertilizing. It has been found that sulphur is valuable for reclaiming swampy lands. Certain crops cultivated upon delta lands respond to sulphur as fertilizer. Sulphur mixed with pulverized phosphate rock slowly oxidizes and then acidifies the phosphate, gradually making it available for plant use. Such a mixture eliminates the usual and more expensive procedure of acidulating the rock dust in order to produce a soluble phosphate. This soluble phosphate has the disadvantage in that although it is immediately useful to the plant, frequent applications are required. This finely divided sulphur when mixed with ground phosphates may be expected to hasten the oxidizing reaction and thus be more efficient than the ordinary forms of sulphur.

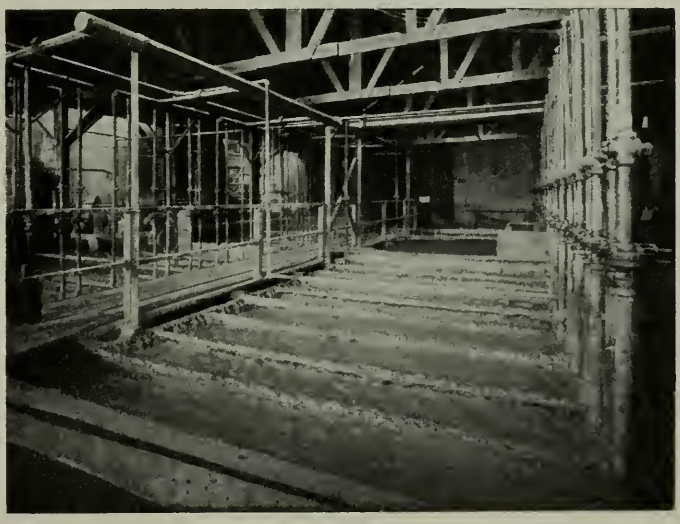
Although the percentage of sulphur compounds in the crude manufactured gas is really quite low, the volume of gas made in the plants where this process is adaptable is so large that the annual production of

ulphur is considerable. Already there has been produced from the three plants mentioned, operating approximately six months, about six hundred tons of dry sulphur. With further improvement in its application and its extension to the other plants, there will be produced from 2500 to 3000 tons of dry sulphur per year. A fair price for this sulphur will aid materially in keeping the cost of purification of gas within reasonable limits and give to the agriculturist a product which he has not had heretofore.

Our gas consumers also may eventually derive a direct benefit from the application of this process. Further improvements may make it possible to use lower grade fuels than gas companies have been able to employ so far. There are coals in California which, were it not for their sulphur content, could be used for gas manufacture. There are also certain oils high in sulphur content which have not been used but which with the depletion of the oil may have to be resorted to. As the general fuel situation continues toward higher prices, the gas companies will be prepared to use lower and lower grade materials while still furnishing to the public an ideal commodity without proportionate increase in rates.

There is a multitude of industries in which sulphur is used and many of them use sulphur by burning. However, this by-product is not adapted for this purpose because it does not burn freely and it is not worthy of special effort to prepare this material for such use, since the cheapest form of sulphur will satisfy in most of these cases. It is the fine division of this by-product in its present form, that should be utilized. For instance, the rubber industry requires a finely divided sulphur. The elasticity and the wearing qualities of their products are dependent upon the fineness of the ingredients. However, it is also important for their purpose that small traces of water be removed but this problem has not as yet, been solved.

The fact that this sulphur is readily wettable is an asset for many purposes, such as, the preparation of pastes, suspensions and solutions. It can be dried sufficiently for the preparation of dusting powders and still retain the property of being readily taken into liquid suspension. This same property, however, makes complete drying a difficult matter. It is not probable that it will be necessary to prepare this sulphur in such a variety of degrees of dryness. The results from the practical tests in the field will no doubt, show for which purpose it can be most economically prepared but, until that time, the search for new uses and other means of refining will be continued.



Apparatus installed at Oakland gas plant for precipitation of sulphur.

Additional Gas-Holder for East Bay— Ten Million Capacity, Waterless Type

Shortly before the close of last year our company's gas department started construction work upon the foundation for a new 10,000,000 cubic-foot gas-holder for East Bay Division.

This event is worth chronicling for two reasons. First, the new holder will be the second one of the capacity stated to be erected in the bay area of our "Pacific Service" territory, and will be located in East Oakland, its construction made necessary by the tremendous industrial expansion and spread of home building activity in that section; second, the new holder will be of the type known as waterless, the second of its kind to be erected in this part of the world.

Sketch of new waterless-type gas-holder to be erected in East Oakland. Capacity 10,000,000 cubic feet.

The industrial and residential expansion referred to has been the subject of considerable study on the part of those charged with the responsibility of providing an adequate gas supply for the company's consumers in the East Bay territory. A thorough analysis of the company's central gas generating plant in Oakland, known as Gas Station "B," and the extensive transmission and distribution system which includes 1400 miles of gas mains, was made before the conclusion was reached that additional holder capacity was required, also, that a large storage holder located in East Oakland would prove the most practical solution of the distribution problem. Accordingly, a suitable holder site was purchased at 50th Avenue and Clement Street, a location approximately four miles from the company's central gas generating plant and only a short distance from the 16-inch high pressure line supplying East Oakland, San Leandro and Hayward. The location is also less than a mile distant from the end of the semi-high pressure trunk line supplying the large area east of the Lake Merritt section.

The Bartlett Hayward Company of Baltimore was awarded the contract and the waterless type of holder was decided upon. This type was developed in Germany where it has been in use about fifteen years.

Approximately two years ago the first holder of this character was erected in the United States and was conceded by all gas engineers to be a great improvement over the old type telescopic holder. The holder will be polygonal in shape, having twenty-four sides and constructed of flanged steel plates 32½ inches wide and 27 feet 10⅜ inches in length. In the interior of this enormous steel shell is constructed a piston built up with steel trusses covered with steel plates similar to the shell plates, and a gas-tight joint is maintained between the edges of the piston and holder shell by means of a canvas seal saturated with tar. A tar reservoir carried on the outer periphery of the piston keeps the canvas wet with tar and this coming in contact with the holder shell lubricates the edge of the piston as well as maintaining a gas tight joint. Any tar leaking at this joint collects in the bottom of the holder and is returned to the tar reservoir by means of a pump automatically controlled by float valve.

When the holder is completed and ready to receive gas the piston rests on the bottom of the holder, gas is then pumped into the holder and the piston, weighing in excess of 1,000 tons, floats on the gas and gradually rises until the holder is filled. As gas is withdrawn from the holder, the piston descends and maintains a constant pressure on the gas at the outlet. Skylights are provided in the roof and an elevator is furnished for inspectors to ascend and descend to the piston in order to inspect the roller guides and tar seal.

The motor-driven compressors, five in number, now located at the compressor station at First and Jefferson Streets, Oakland, will be moved to the new holder site. Three of these compressors are of the reciprocating piston type, combined capacity 750,000 cubic feet per hour at 50 pound pressure. The other two are the centrifugal type, with a capacity of 500,000 cubic feet per hour each at 10 pounds pressure. Gas will be taken into the holder from the 16-inch high pressure line being fed from Gas Station "B" during the hours from 9:00 P. M. to 6:00 A. M. In the daytime gas will be sent out into the high pressure and semi-high pressure systems from this station, leaving the present compressors and transmission line from Gas Station "B" to supply Oakland, Piedmont, Berkeley and Richmond. In this manner adequate storage capacity will be provided and the present trunk lines from Gas Station "B" will be relieved of excessive pressures during peak hour demands and provide capacity for additional growth in all sections of Oakland with the exception of the territory east of Lake Merritt which will be supplied with the new holder station.



Foundation of the new gas-holder under construction.

Before the close of 1925 the construction of the foundation was well under way. The contract calls for the completion of the holder before September 1st of the present year.

The Public Relations Program And Creative Sales Campaign

Throughout the year 1925 our company consistently carried forward its public relations program designed to promote public good will. Efforts were at all times directed to adequate, prompt and courteous service to the consumer, and these efforts were supplemented by a constant endeavor on the company's part to interest the general public in "Pacific Service" as an institution, in its properties, its activities, its accomplishments and its problems.

At all times the white light of publicity was turned upon the company's affairs. Cards were laid upon the table, so to speak, so that the public might be fully informed concerning not only the general policy observed but, also, the actual steps taken by the company to carry out the public trust imposed upon it. This open-door policy, if so it may be called, undoubtedly contributed toward the success of the service selling campaigns, both gas and electric.

The public relations program was carried out in several ways. Prospect and complaint booklets, which were first brought into play about two years ago and which are furnished to all employees for the purpose of reporting complaints or prospective business, were used most effectively throughout the year. Approximately 6,000 reports of prospective business were received through this source. Such complaints as were reported concerned chiefly minor cases of dissatisfaction which probably would have never reached the company in any other way. They were of value, therefore, in that they afforded the company an opportunity to convince consumers of its desire to be of service even in small matters. Every case was given prompt attention and the reaction was, in most instances, favorable to the company.

In all parts of the system group meetings of employees were held, contact men mostly, for the purpose of impressing upon them the realization of their individual responsibility for service. Instructive talks were given concerning the proper treatment of consumers at the counter, the telephone and elsewhere. Suggestions from employees directed to improvement in the methods of dealing with the public were cordially invited; in fact, every effort was made to arouse the interest of the employee in the highest possible type of service.

Division managers and others in positions of authority made a practice of analyzing consumers' complaints, with the object of eliminating the causes therefor. Consumers were encouraged to deal directly with the company in these matters, and although the accounts of approximately 800,000 consumers were kept, involving rendition of approximately 10,000,000 bills during the year, only 249 informal complaints were filed with the California State Railroad Commission.

The policy of active cooperation with dealers in gas and electric appliances was consistently followed by the company. Special cooperative campaigns were planned that were instrumental in stimulating the sale of appliances by dealers, while the company's sales effort, supported extensively by advertising, was directed toward selling the consumers the idea of using more and better appliances.

The educational feature is always a most important part of any public relations campaign or program. During the past year many illustrated lectures were given before associations of all kinds, public, civic, scholastic, social and others, with the avowed purpose of not only taking the public into confidence concerning every phase of the company's activities but, also, arousing the interest of the public generally in the workings of a great public service corporation engaged in but one duty, aiming at but one goal, that of affording the best possible service to the public. In line with this educational feature were sightseeing trips to the company's properties. Four scheduled trips to the Pit River Development were conducted during the year with an aggregate attendance of 693 visitors representative of all lines of business. In addition to these, our company's division managers arranged twenty smaller excursions with an aggregate attendance of 532. Counting

scheduled trips and informal parties it is estimated that about 2,000 persons visited the Pit properties during 1925. Other power plants and properties upon the system were visited from time to time. "No admittance" signs, wherever practicable, are being removed from the company's properties, and replaced with signs bearing the legend "Visitors welcome." In other cases signs are being put up stating that properties may be inspected by securing a permit from the nearest company headquarters.

The creation of constantly improved public relations was the most important purpose of the publicity activities carried on during the year. Our institutional advertising conveyed messages of informative character to the public and aided consumers to secure a fuller measure of benefit from the service rendered. Sales advertising gave information concerning improved appliances, resulting in increased sales and a better appreciation on the part of the public of the value of modern gas and electric equipment. Advertising was conducted consistently in all daily and weekly newspapers of general circulation, a total of 234 publications.

News articles concerning the company's affairs were issued from time to time and brought most favorable results. Returns show that the total amount of newspaper space given to these articles during the year was 33,214 column inches. The clipping bureau handled 36,318 articles relating to the company or the industry, and the great majority of these were very decidedly favorable to the company.

An active sales campaign was prosecuted in all parts of the system during the year, resulting in a very satisfactory increase in volume of new business. In all of this work the public relations value was kept constantly in mind. Over 400,000 contacts were made with consumers or prospective consumers by a carefully selected sales force, all of whom had received special training in the company's service policy. The increased creative sales during the past year added 84,653 kilowatts to the company's connected electric load. In this connection competitive sales activities covering only prospects whose estimated annual revenue to the company was $250 and upwards added 48,371 kilowatts; sales of electric ranges, water heaters, air heaters, commercial cooking and electric refrigeration 27,234 kilowatts; sales of kitchen lighting units, lamps, commercial and industrial, and street lighting added 6,212 kilowatts to the load.

Special effort was made during the year to extend the company's electric distribution lines in order to thoroughly cover all demands for service within reasonable distance of existing lines. The sales plans were also directed as in past years, to the loading of existing facilities, particularly with regard to classes of business in the higher rate fields.

Due to early rains in the first part of 1925 the consumption of electric energy by water companies and by agricultural pumping plants was considerably smaller than in the previous year. There was, also, a falling off in the mining load and in sales to other electric power corporations. These decreases, however, were offset by increased sales for light, heating, cooking and manufacturing. It is of interest to note that whereas the sales for the first eleven months of 1925 increased only 11,569,430 kilowatt hours, or less than one per cent, the electric revenues increased $1,417,000. Increases of 15.40 per cent in sales of electricity for street lighting, 12.48 per cent in commercial and residence lighting sales, 9.85 per cent in manufacturing power and 10.21 per cent in miscellaneous power, heating, cooking, etc., were responsible for this excellent showing.

Gas sales for the year 1925 were stimulated by constructive activity along industrial, hotel and restaurant and domestic lines. The total sales of gas for the year amounted to 16,200,951,000 cubic feet, an increase of six and four-tenths per cent over the record for 1924. The average increase in individual consumption for the year amounted to 238 cubic feet per consumer, or a total of 89,642,938 cubic feet for the total number of consumers served. This increased individual consumption resulted in an added revenue of $96,300. The total revenue from gas sales amounted to $17,360,878, an increase of ten and two-tenths per cent over 1924; this was partially due to an increase in rates (made necessary by an increased oil cost), which averaged approximately 4 cents per 1000 cubic feet sold over the average revenue of 1924.

In increasing gas sales the primary objective was the development of business with a good annual load factor. In this respect domestic gas sales activity was devoted to stimulating the sale of gas ranges and water heaters in accordance with the company's policy of dealer cooperation; while the sale of gas heating systems, such as warm air furnaces, was fostered, major stress was placed upon good and proper installations. The Gas Appliance Society proved an effective means of dealer cooperation to carry on this domestic sales work.

The most important creative gas sales work to build desirable business was directed to our industrial, hotel and restaurant consumers. The importance of this business is indicated by the fact that a total of 7,174 of these consumers used sixteen and three-tenths per cent of the total gas sold during the year. Industrial gas installations were made adding an annual consumption of 235,000,000 cubic feet. Large gas kitchen installations were made in hotels and restaurants, adding an annual consumption of 226,000,413 cubic feet. The sale of gas for these purposes is highly competitive, but the attractiveness of the business justifies the sales effort put forth.

A reference to the table listing the various classifications of industrial consumers and their use of gas gives an idea of the accomplishments along these lines for the system as a whole.

TYPE OF INDUSTRIES	NO. OF SUCH USERS	PRINCIPAL APPLICATION	ANNUAL REVENUE (DOLLARS)
Shipbuilding	10	Metal Treating	$17,653.09
Paint and Varnish	31	Paint and Varnish Proc.	8,149.96
Federal and Municipal	111	Water Heating	30,663.26
Paper, Leather, Wood, etc.	107	Seasonal Material	21,996.05
Chemical Works	84	Processing	37,548.68
Telephone and Telegraph	26	Stand-by Gas Engines	14,528.76
Railroads	24	Metal Treating	10,948.42
Institutions	277	Cooking and Water Heating	102,186.16
Hospitals	101	W. Heating, Cook. and Ster.	76,696.62
Restaurants	2,147	Cooking and Water Heating	787,939.40
Hotels	317	Cooking and Water Heating	130,664.31
Automobiles	422	Heat Treat. and Vulcanizing	75,614.17
Poultry Raising	188	Hatching and Brooding	32,046.67
Glass	26	Bottle Making	51,199.02
Tin and Sheet Metal	66	Heating Machines	57,467.14
Steel and Iron Products	233	Metal Treating	65,437.82
Electrical Products	84	Metal Treating, Rubber and Paint Treating	41,107.44
Iron Foundries	20	Core Ovens	8,877.11
Brass, Copper, Lead, etc.	76	Metal Treating	23,368.67
Printing	171	Type Melting and Drying	81,370.34
Vegetables, Fruits, Food Products	110	Cooking and Preserving	27,598.74
Meat, Fish, Food Products	174	Cooking and Preserving	42,045.02
Bakeries	643	Baking	216,696.02
Candy	240	Steam Kettles and Cooking	95,500.29
Coffee	60	Roasting Coffee	60,250.91
Textiles	95	Steam and Dye Vats	22,760.00
Industrial Water and Space Heat.	451	Air and Water Heating	41,379.42
Laundries	308	Ironing and Washing	68,994.85
Dyeing and Cleaning	498	Dye Vats and Steam Cleaning	51,988.32
Varied Industries	256	Miscellaneous	40,498.43
TOTAL	7,356		$2,343,175.71

Housing the Supply Department— Warehouse Group at Emeryville

In order to effect a centralization of its Supply Department activities, the Pacific Gas and Electric Company in 1924 decided upon the construction of a central supply unit at which location the warehousing, manufacturing, repairing, checking and distributing of the large quantities of materials and equipment used annually for plant maintenance and in new developments could be more efficiently handled. A location for the plant was found in the Emeryville industrial district, north of Oakland, covering an area of 12¾ acres of land adequately supplied with transportation facilities for the distribution of the materials to the different divisions of the company's extensive system.

A group was formed of three major divisions, consisting of a pipe storage and wrapping yard, a warehouse and shop unit and a laboratory. The laboratory is a bureau of the Engineering Department, but while not connected with the Supply Department all materials and equipment carried at the warehouse are tested there; it was deemed advisable, therefore, to have the two adjacent to each other. Each major division was located on a separate unit, or area, as the property is divided into three parts by cross streets.

The buildings were designed by our Engineering Department, while the construction was handled by contract. Work started without delay, and extended over fifteen months. Today the whole is a completed unit. The Supply Department moved into the warehouse building May 15, 1925, the shop buildings were turned over to the Supply Department the following October, while the last to be completed was the laboratory, which was turned over to the Bureau of Tests November 14th.

The pipe yard, situated on the north of the group, is used for the storage and soil-proofing of gas and water pipe used by the different branches of the company. All wrought steel pipe before being used is soil-proofed with a coating of asphaltum and roofing felt especially made for the purpose. Special machines are used to do this work, which heretofore has been done at the different points where pipe was being used. This required the transporting of the equipment from one part of the system to another. It has been found, however, that wrapping the pipe at a central point and its subsequent distribution to the point of use materially cuts down the cost; also the process is continuous and experienced men can be maintained to do the work. Still another advantage is that there is always a stock of pipe available, and shipments can be readily made on short notice. The amount of pipe wrapped each month is in the neighborhood of 440,000 feet and approximately 5,000,000 feet has been wrapped during the past year. In conjunction with the pipe yard, three pipe fitting



The Central Warehouse Group at Emeryville. Machine and electrical shops on the left, warehouse building on the right.

testing machines are used to test all pipe fittings before shipping them to the point of use.

The warehousing, manufacturing and repair shops are situated in the buildings on the central area and make up the Supply Department unit. This consists of five buildings, each designed for the special work for which it is intended. It covers an area of 301,676 square feet, with a ground floor area in the buildings of 129,352 square feet. The yard adjacent to the buildings is paved with concrete and water bound macadam. Suitable concrete loading and unloading platforms twelve feet wide extend along either side of the spur track. These platforms are also used as a runway for transporting material from one building to another. They are of reinforced concrete six inches thick.

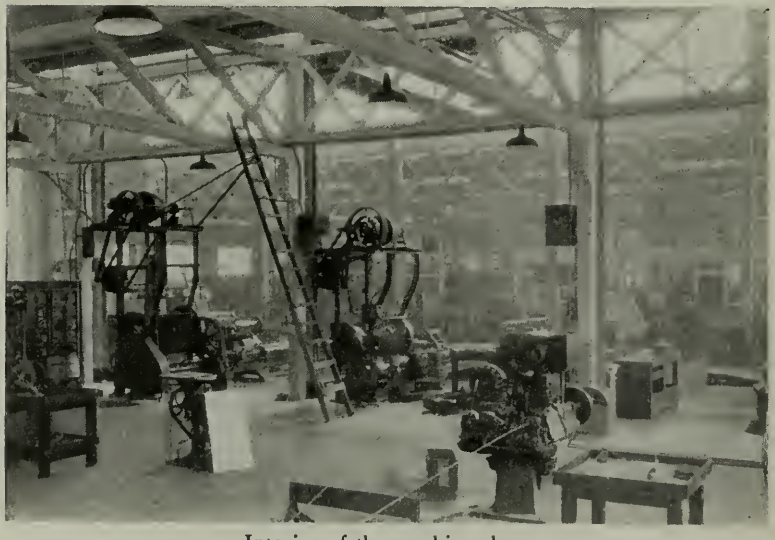


Exterior main warehouse building.

The warehousing is carried on in a building 130 feet wide by 600 feet long, with a second floor 9,000 square feet in area over the central portion for office purposes. The main floor is used for general storage and is equipped with steel bins for the storage of small materials. A dock is situated at the ends of this building for receiving and shipping of materials. These docks are of sufficient size to accommodate three trucks simultaneously. The floor is laid out with runways, and the material is transported over these by means of electrically-driven trucks and stackers.

The executive and accounting departments of the Supply unit are accommodated on the second floor of this building. This portion of the building is steam heated with a low pressure vapor system. The boiler and vacuum pump is on the main floor below.

The manufacturing and repair division of the Supply Department is housed in three buildings to the rear of the warehouse, and on the opposite side of the spur track. The machine and electrical shop building, the largest of the group, is 108 feet long by 264 feet wide, and is equipped with two traveling cranes of 10 and 20 ton capacity. The machine shop is fully equipped with lathes, shears, punches, presses and other machines necessary for manufacturing of switches, junction boxes and reconditioning of worn machinery.



Interior of the machine shop.

The electrical shop is equipped with winding machines, coil varnishing rooms and drying ovens for the manufacture and repair of motors, transformers, and other electrical

equipment, and an oil filter for filtering transformer and switch oil. Two 5000-gallon oil storage tanks buried beneath the insulator storage area are connected to the filters by a suitable pipe system. The electrical testing department is located in this shop and is equipped with the necessary transformers, regulators, and switchboards for testing all the electrical equipment built and repaired by the electrical department, as well as that purchased from equipment companies. Adjacent to this shop is a concrete paved area 50 feet by 108 feet, for insulator storage and testing.

To the north and adjacent to the machine shop are the forge and pattern shops housed in a building 80 by 120 feet. The forge shop contains the regular blacksmith equipment, and the electrical and oxy-acetylene welding departments. The equipment for the electrical welding consists of two motor-generator units of 60-90 volt, 200 ampere capacity, which supplies current for the direct current welding. A 440-volt single-phase alternating current butt welder is also provided. The welding current outlets are of the interlocking switch type, thus safeguarding the workers.

The pattern shop adjoins the forge shop, and is separated from it by a fireproof wall. This shop is fully equipped with the most modern tools for pattern making. Steel shelving provides storage for all active patterns.

The foundry is located north of the pattern and forge shops in a building 60 by 220 feet. All castings of bronze, brass, copper and iron used by the Supply Department are made here. The shop is equipped with an iron cupola of 3000 pound capacity, and three oil burning brass furnaces. A five-ton traveling crane is provided in the iron foundry. A portion of this building provides storage for scrap copper, brass and aluminum.

The laboratory building makes up the third unit of the group and is located on the block to the south of the warehouse building. The building is 98 by 170 feet. The exterior is similar to the other buildings of the group, but the interior has been constructed to meet the highly specialized work carried on by this department. The testing of all materials used on construction and repair work of the company is taken care of in this unit. Special research work is also carried on.

The type of building which would be the most suitable for a group of this nature was the object of much study. After due consideration of all types the class "C" type, with concrete walls and timber frame, was decided upon as being best fitted to meet all of the controlling conditions. The floor of the warehouse is of concrete, while that of the electric and machine shops is of redwood block. The forge and foundry floors are a special sandy clay, well rolled to form a uniform surface. In the pattern shops a double wood floor has been provided. The lighting of all the buildings is accomplished by means of windows and skylights, the relation of floor area to lighting area being in the ratio of approximately 4 to 1. The artificial lighting in the building was designed to give the most uniform working light possible. The offices and laboratory buildings are equipped with Glassteel diffusers which give a semi-indirect lighting, while the shops and warehouse are equipped with dome reflectors for direct light.

All buildings are protected with a fire system directly connected to the fire pump mentioned above, and to the city mains, thus insuring ample protection at all times.

The approximate cost of the whole, including lands, buildings, yards and equipment, was $890,000.

The Supply Department last year handled—including both incoming and outgoing—somewhat in excess of $14,000,000 worth of materials, supplies, apparatus, etc.



Laboratory building.

The Financial Side of "Pacific Service"

Following is a preliminary statement of the Company's income account for the quarter ending March 31, 1926, compared with the same period last year:

INCOME ACCOUNT
THREE MONTHS ENDED MARCH 31, 1926

	1926	1925	INCREASE
Gross Revenue, including Miscellaneous Income	$12,892,006.81	$12,274,542.42	$617,464.39
Maintenance, Operating Expenses, Rentals, Taxes (including Federal Taxes) and Reserves for Casualties and Uncollectible Accounts	7,680,751.50	7,317,734.57	363,016.93
Net Income	$ 5,211,255.31	$ 4,956,807.85	$254,447.46
Net Interest Charges	1,920,772.65	1,816,536.93	104,235.72
Balance	$ 3,290,482.66	$ 3,140,270.92	$150,211.74
Bond Discount and Expense	110,719.66	103,298.54	7,421.12
Balance for Depreciation and Surplus	$ 3,179,763.00	$ 3,036,972.38	$142,790.62

In the first quarter of 1926 the Company made a net addition of 11,824 customers to its distribution systems, of which 6,723 were electric services, 5,015 gas services and the remaining 86 in other departments. In the same quarter of 1925, the net addition was 7,479. This year's showing is about 60 per cent better than that of last year and is indicative of healthy activity in building down to the present time. The total number of active meters on the Company's system as of March 31, 1926, was 825,522, an increase of 54,426 within the twelve months to that date. A very brief summary showing the increase in the number of active meters during the first three months of this year, compared with the same months of 1925 follows:

	NUMBER OF CUSTOMERS SERVED	GAIN DURING MONTH	
		1926	1925
January 31	817,298	3,600	2,550
February 28	822,186	4,888	2,537
March 31	825,522	3,336	2,392
Gain in First Quarter of Year		11,824	7,479

Sales of electricity in the quarter ended March 31, 1926, aggregated 476,004,245 KWH, an increase of 21,737,140 KWH or 4.8%. Gas sales amounted to 4,992,196,900 cubic feet, an increase of 357,904,800 or 7.7% over the corresponding period of 1925.

BALANCE SHEET, DECEMBER 31, 1925

Following is a copy of the Company's balance sheet at December 31, 1925, as certified by Messrs. Haskins & Sells, its independent auditors:

ASSETS

Plants and Properties		$273,815,667.80
Discount and Expenses on Capital Stocks		9,001,485.45
Investments		194,724.93
Trustees of Sinking Funds (excluding Company Bonds in Sinking Funds):		
Cash	$ 223,789.85	
Accrued interest on bonds held in Sinking Funds	153,274.40	
Total Trustees of Sinking Funds		377,064.25
Cash in Hands of Trustees—For redemption of notes matured		3,292.50
Advances for Construction—Leased properties		1,727,154.99

Current Assets:			
Cash		$1,538,865.38	
Notes receivable	$ 420,354.01		
Accounts receivable	4,939,379.86		
Total	$5,359,733.87		
Less reserve for doubtful accounts and notes	60,744.39		
Remainder		5,298,989.48	
Installments receivable from subscribers to first preferred and common capital stocks		342,762.63	
Materials and supplies		6,222,201.70	
Accrued interest on investments		663.96	
Total Current Assets			13,403,483.15
Deferred Charges:			
Unamortized bond discount and expenses		$8,629,693.28	
Prepaid taxes and undistributed suspense items		201,951.30	
Total Deferred Charges			8,831,644.58
Total			$307,354,517.65

LIABILITIES

Capital Stocks of Pacific Gas and Electric Company, including Stocks subscribed for but not fully paid:			
First Preferred Capital Stock		$54,916,531.91	
Common Capital Stock	$79,827,715.00		
Less-Owned by Subsidiary Company	31,696,866.66	48,130,848.34	
Total Capital Stocks of Pacific Gas and Electric Co.			$103,047,380.25
Capital Stocks of Subsidiary Companies not held by the Pacific Gas and Electric Company and Unpaid Dividends thereon			16,303.51
Funded Debt:			
Pacific Gas and Electric Company Bonds		$121,517,000.00	
Bonds of Subsidiary Companies		40,335,800.00	
Total Funded Debt			161,852,800.00
Current Liabilities:			
Accounts Payable		$ 2,194,626.93	
Drafts Outstanding		501,529.27	
Meter and Line Deposits		759,474.21	
Dividends		959,122.79	
Bond Interest Due		447,757.25	
Accrued Interest—not due		1,856,671.77	
Accrued Taxes—not due		2,581,675.45	
Total Current Liabilities			9,300,857.67
Reserves:			
For Northern California Power Company Consolidated—Plant Adjustments and Accrued Depreciation		$ 1,647,658.65	
Depreciation		18,387,921.38	
Insurance and Casualty		707,554.72	
Reserve for amounts charged during 1913, 1914, 1915, 1916 and 1917 to consumers in excess or rates allowed by city ordinances		1,813,760.27	
Total Reserves			22,556,895.02
Surplus			10,580,281.20
Total			$307,354,517.65

CERTIFICATE OF AUDIT

We have audited the books and accounts of the Pacific Gas and Electric Company and subsidiary companies for the year ended December 31, 1925, and

WE HEREBY CERTIFY that, in our opinion, the above Consolidated Balance Sheet is correct.

San Francisco, March 30, 1926. HASKINS & SELLS

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVI APRIL, 1926 NO. 8

Twenty years of steady upbuilding, twenty years of unbroken progress and advancement. Truly a proud record for our company's management to lay before our company's stockholders in an accounting of its stewardship during a term of years that embraced striking periods of prosperity and adversity, of business inflation and business depression, of peace and war.

The Pacific Gas and Electric Company was incorporated in October, 1905, so that the report presented at the annual meeting of stockholders held at the company's general office building in San Francisco April 13th was the twentieth successive annual report of "Pacific Service" activities; and an analysis of the company's growth was included therein from which some interesting facts may be gleaned. From a total of $8,947,162 in 1906, the company's gross revenues in the year 1925 reached $48,066,897. An inspection of the returns by years shows a steady increase during the period from 1906 to 1918 and from that time to the present a still more pronounced advance. A significant fact is that the company's revenues have more than doubled in the past seven years. President Creed in calling the attention of his stockholders to this observes:

"This unbroken record of growth impressively demonstrates the stability and inherent vitality of a business founded, as is that of your Company, on diversified and essential services to a large and increasing population in a territory of abounding and rapidly developing resources."

The story of "Pacific Service" is, in fact, a relation of unremitting effort not merely to meet existing conditions but, in many instances, to anticipate the inevitable future; and through that story may be traced, in great measure, the development, in almost every line of industry, of a section of our Golden State embracing thirty-eight counties and covering an aggregate area of 59,000 square miles. Every well-conducted public utility must keep in the van of progress.

To the grand total of operating revenues for 1925 the Electric Department contributed $28,301,331, or 59.30 per cent, an increase of $1,617,234 during the past year; a sum of $17,360,878 or 36.37 per cent of the total was contributed by the Gas Department, an increase of $1,603,543 during the past year. Despite the enormous strides made in the development and use of electric power during recent years it is noteworthy that the older commodity, gas, not only holds prominent place as a revenue producer but is actually growing in popular favor through the diversified uses to which this most efficient and readily controlled heating agent can be put with profit to the consumer. At the present time the number of consumers receiving electric service from our company stands at 405,779, an increase of 27,028 over last year, and the number of gas consumers at 387,707, an increase of 22,311 during the past year.

Behind these figures stand the immense physical properties of the comprehensive organization known far and wide as "Pacific Service." On the electric side, our company at the close of 1925 operated twenty-eight hydro-electric plants, with a total installed capacity of 534,819 horsepower, and four steam-electric plants with a total installed capacity of 190,349 horsepower; in all 725,168 horsepower. The output of electric energy from these during the past year was: hydro, 1,478,364,219 kilowatt hours; steam, 145,542,575 kilowatt hours. Add to these figures 373,251,426 kilowatt hours of purchased and consigned power and the total comes to 1,997,158,220 kilowatt hours. Electric service was furnished to 289 cities and towns in California and to a very large and prosperous rural area of 59,000 square miles in extent with a total population conservatively estimated at approximately two and a quarter millions. On the gas side, our company's manufacturing resources embraced fifteen plants

from whose output the sales in cubic feet totaled 16,200,951,000 during 1925. Of this total San Francisco, operating two plants and extending service to twenty-one cities and suburban districts, was responsible for 7,902,818,800 cubic feet, while Oakland, serving ten cities and suburban districts, came second with sales of 5,160,890,900 cubic feet.

Increases in service and revenue therefrom were also noted from the Water, Steam Sales and Telephone Departments of the company.

These figures speak for themselves. They reveal in pointed fashion the great work of upbuilding that has been in progress ever since the Pacific Gas and Electric Company was incorporated. In the twenty years since its organization our company has increased its plant account by $201,035,834 through new construction and the acquisition of additional properties. A comparative table showing progress through the years indicates that the construction budget sprang into considerable figures in the year 1920, with a total of $10,600,208.89, and that during the period from that date to the close of 1925 there was expended in new construction work an aggregate of approximately $120,000,000. That the purposes to which this money was applied were many and varied may be gathered from the fact that the great Pit River Development, of which so much has been written and which as completed to date represents 44 per cent of the total hydro-capacity of our company's electric generating system, absorbed but a little over $36,000,000, or about 30 per cent of the total expenditure.

During the past year gross construction expenditures aggregated $27,346,475.04, an average of more than $90,000 per working day. The major accomplishment of the year was the completion of Pit River No. Three power-plant, with an installed capacity of 108,580 horsepower, bringing the total installed capacity of the developments on the Pit River and its tributaries up to 235,926 horsepower. Even the lay mind can realize that the addition of this volume of available power to our company's service resources, combined with the constantly increasing public demand for electric energy due to industrial expansion and growth of population, must entail a considerable amount of work in the enlargement and improvement of our company's electric transmission and distribution facilities from end to end of the "Pacific Service" territory, involving new lines, new substations, reinforcement and enlargement of existing ones, betterments of equipment, etc. An unusual amount of this work was accomplished during the past year, approximately $4,000,000 being expended upon sub-station construction in San Francisco and East Bay divisions alone.

The Gas Department, too, had an active year, expenditures for additions and betterments approaching the $6,000,000 mark. Five new gas generators with the combined total daily capacity of 21,000,000 cubic feet were added to the system during the year. There are now 53 oil-gas generators in operation at various points in the "Pacific Service" territory, with an aggregate daily capacity of 106,000,000 cubic feet.

Our company's new general office building in San Francisco was completed and occupied during the early part of the year. The housing under one roof of the executive and administrative offices and head office departments unquestionably resulted in an all around increase of efficiency.

Among other important items of building construction may be mentioned a large new general warehouse located at Emeryville near Oakland. This warehouse, with adjoining repair shop, testing laboratory and storage yard, occupies an area of twelve and three-quarters acres accessible to water and railroad transportation facilities.

The company's financial affairs are in excellent condition. An issue of $10,000,000 par value First and Refunding Mortgage 5 per cent Series "D" Bonds was sold in June, 1925, on terms more favorable than any heretofore obtained. The relatively low cost of this bond money is attributable in a substantial degree to the steady improvement in the status of the company's secured obligations brought about primarily by the large amount of stock financing within recent years.

In the latter part of December, 1925, authorization was secured from the California State Railroad Commission for the sale of $2,500,000 of First Preferred 6 per cent Stock, and $452,000 par value was sold to 308 purchasers in the last week of the year. The remainder of this issue, and another of $2,500,000, for which an additional authorization was secured from the

Commission, was disposed of before the end of February, 1926, or within less than two months from the first announcement of the offering, at prices of $98 and $99 per share, merely through the insertion of a few advertisements in local newspapers. The total selling expense in disposing of the $5,000,000 of preferred stock was 22.4 cents per share, 3,784 individual subscriptions being received, or an average of 13.2 shares per subscriber.

Total sales of common stock last year aggregated $5,324,900 par value. This entire amount was disposed of practically without advertising, at a selling cost of 12.4 cents per share. There were 6,141 individual sales, averaging eight and two-thirds shares per purchaser. The stock was sold at approximate market prices ranging up to $109 per share.

At the close of 1925 there were approximately 35,000 stockholders, with average holdings of 30 shares apiece. Approximately 3,200 of the company's employees are stockholders, with aggregate holdings of $3,367,800 par value of stock.

The average number of employees during the year was 11,288, and the average monthly salary $145.50 per employee. Since the establishment of the Personnel Department four years ago 75,995 applicants for employment were interviewed, of whom 3,254 men and 906 women were given positions in the company. The Pacific Service Employees' Association, a voluntary organization of company employees, now has a paid up membership of approximately 7,500.

The foundation of good public relations is good service. The company's efforts to impress this axiomatic principle of utility operation upon all employes through a well organized educational program are meeting with marked success. Informal complaints filed with the State Railroad Commission last year numbered only 249, or an average of about three complaints per 10,000 consumers. When it is recalled that keeping the accounts of 800,000 customers involves the rendition of approximately 10,000,000 bills annually (considering gas and electric accounts separately), the fact that less than 250 individual consumers saw fit to file complaints with the regulatory body indicates an excellent standard of service and accounting.

The foregoing may be regarded as the high spots in the "Pacific Service" record for 1925. This record was laid before the stockholders at the annual meeting and supplemented by oral addresses by President W. E. Creed, First Vice-President and General Manager F. A. Leach Jr., and Second Vice-President and Treasurer A. F. Hockenbeamer. The meeting was distinguished by the adoption, by unanimous vote, of a resolution approving the acts and commending the course of the company's administration and by the reelection for another twelvemonth of all the company's officers and directors with the exception that Mr. C. K. McIntosh was temporarily substituted on the directorate for Mr. F. B. Anderson during the latter's absence abroad.

Comments of the public press upon our company and its record have been uniformly of an encouraging nature. The following from a recent issue of the *Boston Commercial,* an old established publication of the conservative order, may be taken as a fair example:

"Many reasons could be attributed for the comparative steadiness of Pacific Gas & Electric in periods of stock market depression. The chief reason, of course, is the fact that the company has a splendid record of earnings and achievements dating back twenty years. It is ably managed by men who know their business, is conservatively capitalized and has prospects for large sale growth for an indefinite period in the future. It pays $8 a share, and ranks among the prime stock investments; its dividend is reasonably safe; its management in providing for the present is also building for the future."

And now for 1926. As during last year, our company is engaged in a construction program of considerable magnitude, involving expenditures estimated around $25,000,000. An outline of the prominent features of this was given in the January number of PACIFIC SERVICE MAGAZINE. It is all in line with our company's announced policy of extending dependable service to the greatest possible number of people through liberal extensions and always at the lowest cost consistent with the class of service rendered.

PACIFIC GAS & ELECTRIC COMPANY

A California Corporation

Managed by Californians — Operated by Californians

"Pacific Service" Represents (as of December 31, 1925)

10,800	employed in all departments.
$274,000,000	capital invested in gas, electricity, railroads, steam, water and telephone plants.
59,000	square miles of territory in which it operates—an area greater than that of England and Wales.
34,863	stockholders.
38	counties of the state in which it transacts business.
813,698	consumers served with gas, electricity, water and steam.
2,158,000	people in 38 counties, which is over 50 per cent of the State population.
291	cities and towns in which it supplies service directly and through other companies.
$19,710,266	annual wages paid employes, year ending December 31, 1925.
$3,344,022	taxes, state and county, year ending December 31, 1925.
$1,151,578	taxes, Federal Government, year ending December 31, 1925.
534,819	horsepower developed in 28 electric water-power plants.
190,349	horsepower developed in 4 electric steam plants.
725,167	total horsepower developed in 32 plants.
1,351,798,486	kw. hrs. sold, year ending December 31, 1925. This is equivalent to the effort of 4,505,955 men.
16,200,951,000	cubic feet of gas sold, year ending December 31, 1925.
16	gas plants.
12,800	miles of transmission and distribution lines. Greater than the distance between San Francisco and Calabar, West Africa.
4,108	miles of mains used in distributing gas. Greater than the distance between San Francisco and Bogota, Colombia, South America.
1,100	miles of mains and ditches used in distributing water.
1,100	miles of track of street railway supplied with electric power.
71,206,690,280	gallons of water storage capacity in 110 lakes and reservoirs. This amount of water would supply the City of San Francisco at the present rate of consumption for nearly 5 years.
115,718	acres of land owned in California.
270	parcels of property owned in cities and towns.
4,542,926	barrels of California Oil used, year ending December 31, 1925.
195,552	horsepower in agricultural motors depending on "Pacific Service."
591,645	horsepower in mining, electric railways, manufacturing and other motors depending on "Pacific Service."
39,028	street lamps, gas and electric, lighted by "Pacific Service."
7,805,309	incandescent lamps nightly lighted.
1,512,931	horsepower connected to system.

Pacific Gas and Electric Company

General Office: 245 Market Street

San Francisco

Branches in all principal cities and towns of 38 counties of North Central California.



Vaca-Dixon Substation, the terminus of the 220,000 volt lines from the Pit River power houses.

Vaca-Dixon Substation, shown above, typifies the Company's efforts to combine in its structures beauty and dignity of design with the maximum of utility.

The funds provided by the sale of the Company's stocks and bonds are invested in properties such as this, devoted to the service of the public. Every dollar is accounted for to the State regulatory commission.

Pacific Gas and Electric Company is one of the strongest and most rapidly developing public utilities in America. Its properties are well maintained, its standards of service are high, its business is stable and its earnings are amply supported by physical values.

The Company's stocks and bonds are held by over 80,000 investors, each one of whom is receiving interest or dividends regularly.

Pacific Gas and Electric Company

STOCK SALES DEPARTMENT

245 MARKET STREET, SAN FRANCISCO, CALIF.

PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO



CHERRY ORCHARD UNDER IRRIGATION—SANTA CLARA COUNTY

Vol 16 JULY 1926 No 3

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER	A. B. C. DOHRMANN	FRANK A. LEACH, JR.
FRANK B. ANDERSON	JOHN S. DRUM	NORMAN B. LIVERMORE
CHAS. L. BARRETT	F. T. ELSEY	JOHN A. McCANDLESS
W. E. CREED	D. H. FOOTE	JOHN D. McKEE
W. H. CROCKER	A. F. HOCKENBEAMER	C. O. G. MILLER

OFFICERS

W. E. CREED	*President*
FRANK A. LEACH, JR.	*First Vice-President and General Manager*
A. F. HOCKENBEAMER	*Second Vice-President and Treasurer*
D. H. FOOTE	*Third Vice-President and Secretary*
CHAS. L. BARRETT	*Assistant Secretary*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, JR., Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney	LAW DEPARTMENT
C. P. CUTTEN, Attorney	RATE DEPARTMENT
R. J. CANTRELL, Manager	PROPERTY AND TAX DEPARTMENT
E. W. HODGES, General Auditor	ACCOUNTING DEPARTMENT
H. T. TERRY	CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager	CREDIT AND STOCK SALES DEPARTMENTS
JOHN H. HUNT, Purchasing Agent	PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent	SUPPLY DEPARTMENT
E. G. McCANN, Manager	PERSONNEL DEPARTMENT
	ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT
O. W. PETERSON	Engineer of General Construction
E. H. STEELE	Engineer of Line Construction
F. R. GEORGE	Engineer of Operation
GEO. H. BRAGG	Engineer of Maintenance
	DEPARTMENT OF ENGINEERING
J. P. JOLLYMAN	Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER	Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE	Chief of Division of Civil Engineering
F. M. HARRIS	Chief of Bureau of Specifications and Estimates
O. A. KNOPP	Chief of Bureau of Tests and Inspection
	DEPARTMENT OF EXECUTIVE ENGINEER
F. C. PIATT	Valuation Engineer of Electric Properties
J. T. RYAN	Valuation Engineer of Gas, Water and Railway Properties
B. B. BECKETT	Rate Engineer
S. B. SHAW	Automotive Engineer
W. G. JACK	Manager Land Department
	GAS CONSTRUCTION AND OPERATION DEPARTMENT
FRANK WILLS	Engineer of Production
R. S. FULLER	Engineer of Distribution
HARRY J. SMITH	Engineer of Construction
	PUBLIC RELATIONS AND SALES DEPARTMENT
R. W. ROBINSON	Assistant to Vice-President in Charge of Public Relations and Sales
DON C. RAY	Manager Bureau of Public Relations
N. R. SUTHERLAND	Manager Commercial Department
H. M. CRAWFORD	Sales Manager
R. T. STEPHENS	Manager Electric Sales
FORREST U. NAYLOR	Manager Gas Sales
J. CHARLES JORDAN	Manager Publicity Department

W. B. BOSLEY
General Counsel

JOHN P. COGHLAN
Assistant to the President

F. S. MYRTLE
Editor-in-Chief Pacific Service Magazine

DIVISIONS AND MANAGERS

DIVISION MANAGERS		DISTRICT MANAGERS		HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION			Marysville
		J. V. KYLE	Colusa District	Colusa
I. B. ADAMS	DE SABLA DIVISION			Chico
H. M. COOPER	DRUM DIVISION			Auburn
		L. H. HARTSOCK	Nevada District	Nevada City
L. H. NEWBERT	EAST BAY DIVISION			Oakland
		J. H. PAPE	Berkeley District	Berkeley
H. C. ROSS	FRESNO DIVISION			Fresno
H. G. RIDGWAY	NORTH BAY DIVISION			San Rafael
		L. J. PETERSON	Petaluma District	Petaluma
		C. D. CLARK	Napa District	Napa
		C. D. CLARK	Vallejo District	Vallejo
		M. G. HALL	Santa Rosa District	Santa Rosa
E. W. FLORENCE	SACRAMENTO DIVISION			Sacramento
		C. E. SEDGWICK	Solano District	Dixon
		J. W. COONS	Yolo District	Woodland
HENRY BOSTWICK	SAN FRANCISCO DIVISION			San Francisco
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION			Modesto
		W. E. ESKEW	Electra District	Jackson
		C. R. GILL	Modesto District	Modesto
		J. H. FAGG	Stockton District	Stockton
		CHAS. H. NOACK	Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION			San Jose
		W. T. KELLOGG	Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION			Redding
H. B. HERYFORD	WEST SIDE DIVISION			Red Bluff
		STEPHEN GOIN	Willows District	Willows
		CHAS. HUGHES	Red Bluff District	Red Bluff

Pacific Service Magazine

Volume XVI Number 9

Contents for July, 1926



ELECTRA POWER PLANT ON THE MOKELUMNE RIVER *Frontispiece*

SALT SPRINGS DEVELOPMENT UNDER WAY—
Construction work begun upon a project for the enlargement of our company's Electra power system—Reviving interest in the historically famous Mother Lode region - - - *F. S. Myrtle* 271

WORLD'S TALLEST TRANSMISSION TOWER COMPLETED - - - - - - - - *Walter Dreyer* 279

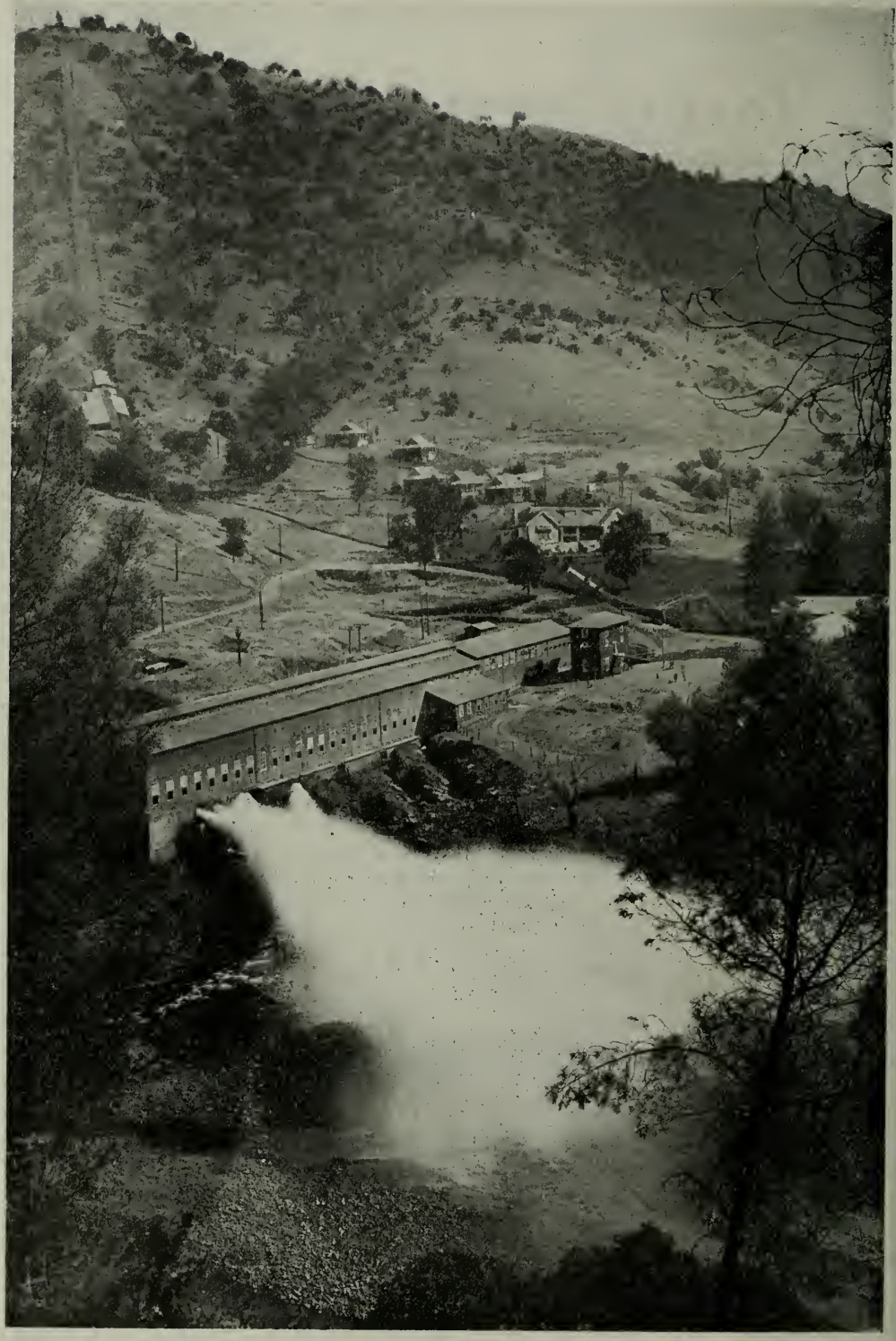
THE ELECTRIC TRANSMISSION OF POWER—
Address before the Faculty and Students of Princeton University - - - - - - - - *J. P. Jollyman* 285

"PACIFIC SERVICE" AS A CO-OPERATIVE ENTERPRISE—
MELONES POWER PROJECT - - - - - - - - 295

THE "PACIFIC SERVICE" ROLL OF HONOR - - - - - - 298

THE FINANCIAL SIDE OF "PACIFIC SERVICE" - - *A. F. H.* 300

EDITORIAL - - - - - - - - - - - - - - 302



Our company's hydro-electric plant at Electra, on the Mokelumne river near Jackson, Amador County.

PACIFIC SERVICE MAGAZINE

Volume XVI JULY, 1926 Number 9

Salt Springs Development Under Way

Construction work begun upon a project for the enlargement of our company's Electra Power System—Reviving interest in the historically famous Mother Lode region.

By FREDERICK S. MYRTLE

In the beginning of the present year the public announcement was made that our company, with the formal approval of the Federal Power Commission in Washington, was about to enter upon the development of water-power projects upon the upper reaches of the Mokelumne River in Amador and Calaveras counties; also, that this work was to be undertaken under a government license transferred to our company from the original private owners; also, that the purpose of this work was to provide additional power and water storage facilities for the company's Electra power system in Amador county.

This work, it was explained, would involve the construction of a dam on the Mokelumne River at Salt Springs, approximately four miles upstream from the Junction of the river with its principal tributary, the Bear, which flows in from the northward; the construction of a water conduit from the intake at the dam a distance of, in round numbers, twenty-five miles to Tiger Creek, at which point it was proposed to drop the water 1200 feet to operate a new power house, to be called the Tiger Creek power house, whose electric generating capacity it was decided would be around 40,000 horsepower. At this point, it was stated, the new project would be merged with the old Electra system, which at the present time consists of two canals, the Upper and Lower Standard, which convey the water a distance of twenty-two miles from their intake at Tiger Creek to the point whence it it dropped down a precipitous incline to turn the wheels of the generators in the great power house at Electra on the bank of the river below.

It is now of record that all preliminaries, including rights of way, etc., have been adjusted and work has been started in earnest. The proposed dam site lying in a country not too easy of access for transportation purposes, the preliminary work in such instances consists mainly of road construction and the establishment of power service from the nearest point of distribution. This preliminary work our company is now engaged upon and, with it, the revival of interest in a region of California which is not only interesting from a historical standpoint but, also, from the fact that here, in the region of the Mother Lode which includes some of the most famous mines in history stretching in a chain along the ridge from Plymouth to Angel's Camp and recalling to the memory of man famous names such as Alvinza Hayward, W. S. Hobart and others, of the long ago in California, some of the early experiments in the long distance transmission of electric power were made.

The development of hydro-electric power on the Mokelumne River had its genesis in 1890 when the Blue Lakes Water Company was incorporated. This organization utilized as its operating force the water supply from a cluster of lakes in Alpine county, lying at an elevation of 8,000 feet above sea level and nestling under some of the most majestic peaks in the Sierra Nevada Range, including Border Ruffian and The Nipper, well known to the summer tourist. These lakes, all of which are in operation today, were known as Upper and Lower Blue Lakes, Twin Lakes and Meadow Lake. To these in later years was added a reservoir formed by damming the Bear River, a tributary of the Mokelumne and



The Mokelumne river at Dead Man's Flat dam site.

lying some distance to the westward of the original cluster. In 1890 the Blue Lakes Water Company decided to go into the power business with the aid of this available water storage and constructed a plant about four miles down stream from the present Electra plant to supply energy to the mines in the Mother Lode region of Amador and Calaveras counties. This plant was completed in 1897. The demand for power, however, exceeded all expectations and so, to take care of the additional demand, the Standard Electric Company of California was incorporated in November, 1897 and began construction of the first Electra plant at a point on the north bank of the Mokelumne River about three miles from where the highway from Jackson crosses the river on its way to Mokelumne Hill, San Andreas and Angel's. The ditch system of the Blue Lakes Water Company then consisted of what is now known as Lower Standard canal, which diverted the waters of the Mokelumne at Tiger Creek, and the Amador ditch, a conduit which brought the water into Electra from the northwest. Later on the company constructed the Upper Standard canal, about 200 feet in elevation above it and parallel to it. This system, of course, was made a part of the projected power development.

Before it was completed this original plant of the Blue Lakes Water Company burned down. It was partly restored, but later it was abandoned. A coterie of enterprising capitalists and engineers headed by Prince Poniatowski, Wm. H. Crocker, Alfred Tregidgo and others, then undertook the construction of the great Electra plant which is now the central feature of the present new development work. That took place in 1902.

At the time of the completion of the Electra plant it embodied the best features of high head power development. The Upper Standard canal delivered water into what is known as the Petty reservoir, on a plateau above Electra, and from this the drop was and is today, 1450 feet to the power house. The Lower Standard, reinforced on its journey by the water from the Amador ditch, fed into a picturesque body of water known as Lake Tabeaud, from which the drop was a little over 1250 feet to the power house. The power house was equipped with Stanley motors of an aggregate capacity of 26,000 horsepower. A transmission line was constructed to the Bay region and power was wholesaled to the San Francisco Gas Company. This Standard system was taken over in March, 1904, by the California Gas and Electric Corporation, a combination of power interests whose most important features



Mokelumne River just above Salt Springs.

included the Sacramento Railway, Gas and Electric Company, the Bay Counties and Valley Counties Power Companies, the Standard Company and the Oakland Gas Light and Heat Company. In 1905 the California Gas and Electric Corporation merged with the San Francisco Gas and Electric Company and became what is now known far and wide as "Pacific Service."



Calaveras Bald Rock. Taken from lower end of Dead Man's Flat and at beginning of rapid fall in river.

The Electra power system has been a consistent and regular contributor to the "Pacific Service" power pool. Lately, however, plans have been under consideration for enlarging its water storage and, also, its power generation and distribution facilities. The Salt Springs project, which is now on its way to become an accomplished fact, is not new. It was commenced many years ago and was promoted by the General Electric Company of California. It was reported that this company had obtained the necessary rights from the State and Federal authorities for the use of water and vacant land. After a time, however, the company withdrew and allowed any rights it possessed to lapse. Later on Mrs. Mary Ives Crocker and Mr. F. W. Preston of San Francisco, holders of a considerable stretch of forest territory along the banks of the Mokelumne in that section, made application to the Federal and State governments for a similar project with, in addition, the use of the water to be impounded by the proposed dam for the purpose of irrigating lands below the development and in the vicinity of Jackson. These interests in the course of time perfected their rights and obtained from the Federal Power Commission a license for the construction of the proposed development. These rights at the close of last year were sold and transferred to our company, with the sole exception of the right of use of 60,000 acre feet for storage for irrigation purposes. Our company on its part contracted to construct the dam and reservoir at Salt Springs which should furnish storage facilities of the capacity stated.

The site of the new development is about fifty miles east of Electra. To proceed by road the way lies from Electra to Jackson and from that point a distance of about thirty-five miles over the Alpine highway, a much traveled means of transportation between the mountains of California and the plains of Nevada and which, before it became a highway in the modern sense of the term, took in bits of the famous Kit Carson trail and bore witness to many a death struggle in the days when ox teams plowed their weary way across the continent.



The Salt Lake and Mokelumne River Canyon below Salt Springs.

The way lies over a ridge that separates the watershed of the Mokelumne river from that of the Consumnes. The scenery is quite typical of the Sierra Nevada range. On the Mokelumne side the traveler's gaze ranges over canon after canon of fir-topped slopes, with the arboreal wonders of Calaveras in the distance, for the Mokelumne River is the boundary line between Amador county and the county that Bret Harte has glorified with his poetical prose. On the north side of the ridge the eye travels over the Consumnes to the Placerville grade and the American River country.

A deal of the early history of California was made here. At one point on the highway from Jackson and just about opposite the site of Salt Springs dam is the summit of Peddler Hill at an elevation of 7280 feet above sea level. Ten miles farther on the traveler reaches Tragedy Springs, a spot commemorative of a gruesome happening on the night of June 21, 1848, when two gold seekers are said to have been slain by Indians. Their graves surrounded by piles of stones and decorated with bits of evergreen have lain there through the years, on that silent eminence where at night naught but the occasional soughing of the wind breaks the death-like stillness. Their names and a short description of their fate are carved upon a neighboring pine.



Calaveras Bald Rock and Mokelumne River just above Salt Springs dam site.

Another spot reminiscent of early days is called Maiden's Grave. Here Rachel Melton, a young unmarried woman, lies buried since 1850. A tiny American flag waves over her resting place and her story is to be found in the annals of Amador county.

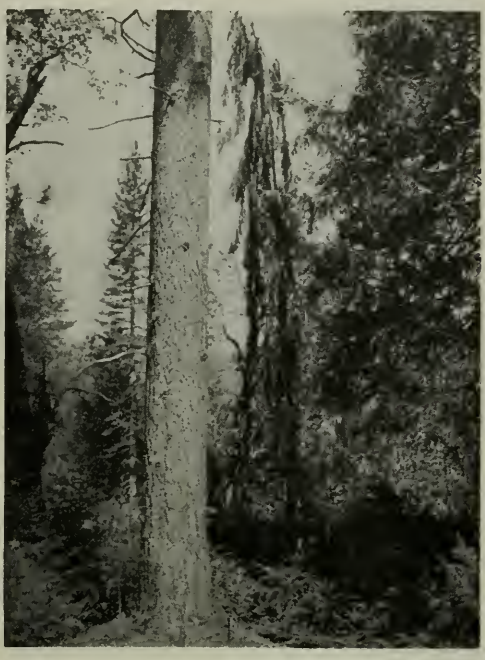
Landmarks along the route, which runs in a northeasterly direction from Jackson, are Pine Grove, Cook's and Ham's, all typical wayside resorts. Thirty-five miles out from Jackson lies a Forest Ranger station, and at this point our company is busily constructing a road which plunges down the slope in the direction of Beaver Creek and to a point where the Bear River joins the Mokelumne. At the time of writing the road has descended about 800 feet, but there is considerable more to do, for the turning point on the highway is some 6000 feet above sea level. At the time of writing some 50 men are at work with dynamite and drill and steam-shovel carving this new highway out of brush and rock; and a temporary construction camp is pitched under the firs at the best available point nearest to the work. Counting the road down the hill and its continuation along an eminence parallel with the north bank of the Mokelumne there will be twelve miles of specially constructed road between the Alpine highway and Dead Man's Flat, where the site has been marked for the Salt Springs dam and reservoir.

The Mokelumne river rises in the upper reaches of the Eldorado and Stanislaus national forests, a wide natural watershed lying southeast of our company's Blue Lakes water system in Alpine county. To the natural run-off there is added the water from Upper and Lower Blue Lakes, Twin Lakes and Meadow Lake, a cluster of reservoirs lying under the lee of the Border Ruffian, a rugged 8500-foot peak of the Sierra Nevada Range, and which is reached by road from the lower end of Lake Tahoe by way

of Hope, Faith and Charity Valleys, and crossing the Nevada highway which runs into Reno by way of Markleeville. The water from these reservoirs is conveyed into the Mokelumne river by a small tributary stream called Deer Creek and is carried a distance of a little over twenty miles to the Salt Spings dam site. Bear River reservoir lies on the river of that name at a point just under Peddler Hill and is reached by a road which turns off the Alpine highway two and one-half miles above the Ranger Station. Bear River, reinforced by the waters of Beaver Creek, flows into the Mokelumne about four miles below the Salt Springs dam site.

Dead Man's Flat is a small open space between towering granite cliffs. It lies at an elevation of 3800 feet above sea level and its distinguishing scenic feature is an immense granite cliff called Calaveras Bald Rock, which stands out as a majestic sentinel amidst its surroundings of fir and pine. Cliffs in excess of 1000 feet rise from the stream on either side of a narrow gorge at this point, where the natural course of the Mokelumne will be checked by what is estimated will be the largest and most imposing rock-filled dam in the West.

The dam as proposed will be of the rock fill type 220 ft. in height, and will contain more than 1,200,000 cubic yards of rock fill. When constructed this dam will be one of the largest of its type in the world, exceeded in height only by the Dix River Dam recently constructed in Kentucky.



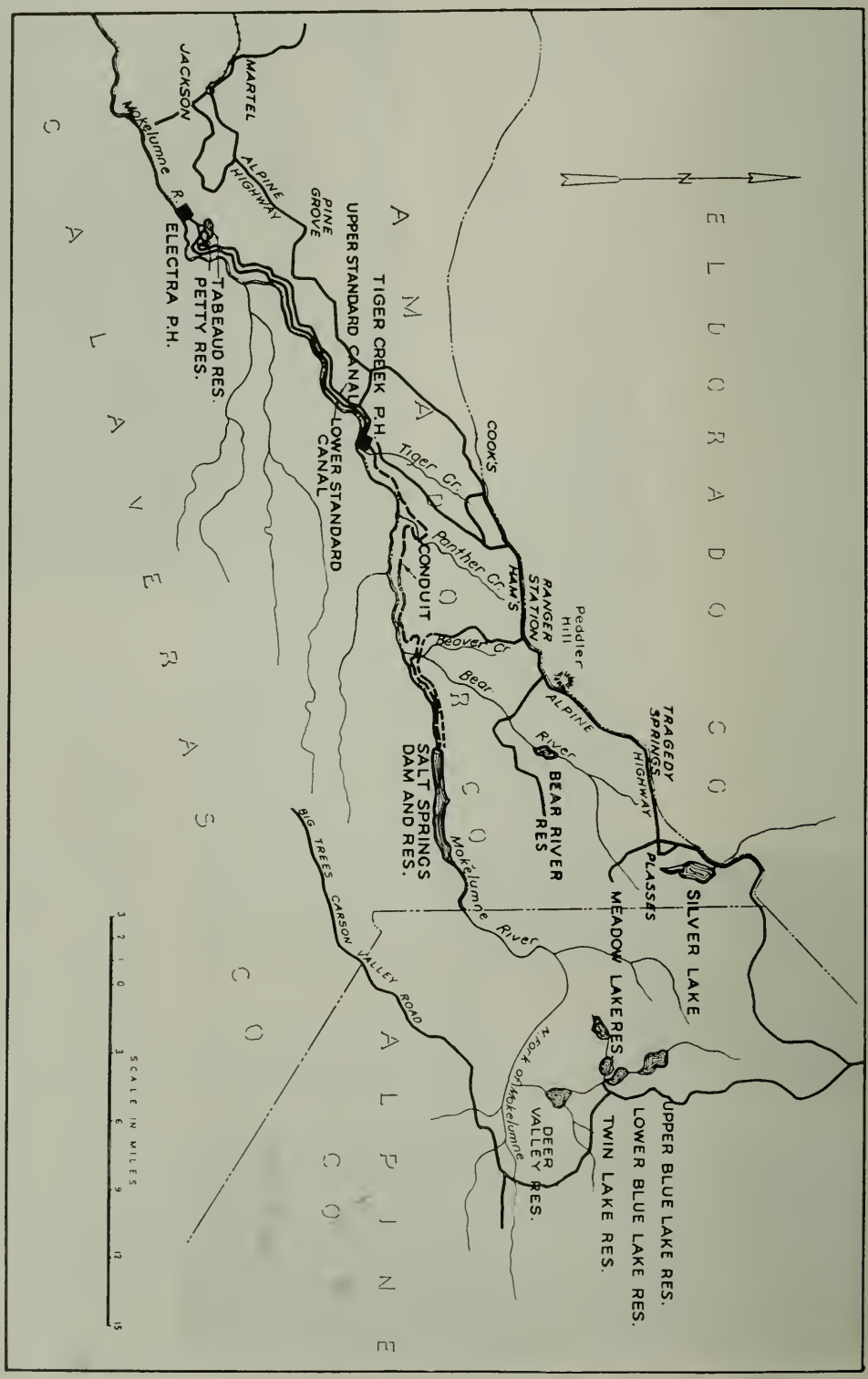
Giant silver fir at Tiger Creek, near the sawmill. Said to be a rare specimen.

The completion of this dam will create a reservoir at the site of 60,000 acre feet and upwards storage capacity.



A glimpse of upper Blue Lake—Typical of Alpine County scenery.

The storage thus created, together with the existing storage on the Mokelumne River watershed, will make possible the regulation of the stream to practically a continuous flow of 300 cubic feet per second. To make use of this flow through the head existing between Salt Springs Dam and Tiger Creek at the head of the existing Upper Standard Canal, a conduit some 23



Profile map of our company's projected hydro-electric development at Salt Springs, on the upper reaches of the Mokelumne river above Electra.

miles long of 350 second feet capacity will be constructed. Due to the roughness of the country and inaccessibility of the project the construction of this conduit will be quite a notable feat. At the end of the conduit on the ridge above Tiger Creek there will be constructed a small forebay from which penstock pipes varying in diameter from 90 in. at the top to 52 in. at the bottom will lead to the power-house, developing a static head of 1247 ft. The total installation proposed at Tiger Creek plant is 35,000 kv.-a. This plant will be connected to the existing system by a transmission line on steel towers from Tiger Creek to Electra Power House. It is to be operated at 110,000 volts.



Our company's clubhouse at Electra.

The value of this water storage will be understood when it is explained that not alone for power purposes will it be used, for, when the proposed projected development has been completed there will be water in plenty for the irrigation of lands on the lower Mokelumne, including the town of Lodi and the surrounding country.

From the Salt Springs dam the water will be conveyed by open concrete-lined conduit and tunnel (where necessary) a distance of twenty-five miles to the point which marks the confluence of Tiger Creek with the Mokelumne. Here will be constructed the Tiger Creek Power House, with as before stated, an available head of 1200 feet. Here one comes into familiar country, for Tiger Creek sawmill dates from the early construction days of Electra system. It was there that lumber for the construction of that system and its subsequent maintenance was cut. Tiger Creek is reached by a road branching off from the Alpine highway at a point near Barton's, about twenty miles out from Jackson, whence the distance is between three and four miles to the sawmill and two miles further on to the junction of Tiger Creek and the Mokelumne, the site of the projected power house.



Lake Tabeau, forebay reservoir at Electra.

From Tiger Creek the Upper Standard canal belonging to the old Electra system will probably be made use of as conduit for the water, though its capacity will be enlarged and its type of construction much improved by concrete lining. Arriving at Electra there will be further changes. At the present time the equipment of Electra Power House is of 26,000 horsepower generating capacity, but the equip-

ment is old and it is now proposed to replace it by fewer units of larger capacity. In other words, there will be a complete making over of the system from end to end.

The value in kilowatt hours to the electric consumer will be considerable, for the completed development will double the amount of water now available for power and irrigation purposes and will more than double the output of electric energy from the Electra system.



Another view of the projected dam site at Salt Springs.

Details for the completion of construction plans are being handled by the Department of Engineering. At the present time additional surveys are being made at the dam site by a corps of engineers under Mr. Grover Green. The Department of Electrical Construction and Operation has charge of all construction work. Mr. O. W. Peterson is construction engineer under Mr. P. M. Downing. Mr. G. M. Wehrle is superintendent on the job. For the present the company's established headquarters are at Martell, terminus of the railroad which leaves the Southern Pacific's main line at Galt and runs up country through Ione, but as soon as the road to the dam site is open headquarters will move up country. It is expected the road will be completed this year.

World's Tallest Transmission Tower Completed

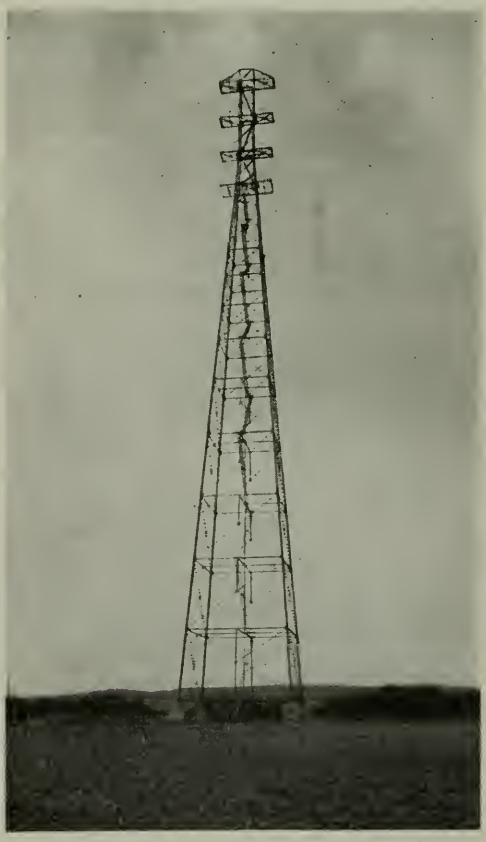
By WALTER DREYER, Department of Engineering

In the January issue of PACIFIC SERVICE MAGAZINE there appeared an article describing the extension of the 220,000-volt Pit River line from Vaca-Dixon south to the site of the new Contra Costa Substation. It is the purpose of the following article to briefly supplement the preceding one by reviewing the necessity for the construction of the line, pointing out the various methods which were considered in designing the river crossings and describing the tower structures in more detail.

The 220,000-volt Pit River Transmission Line of the Pacific Gas and Electric Company was first placed in service in the fall of 1922. The line extended from Pit River No. 1 Power House, 202 miles south to Vaca-Dixon Substation, where the voltage was reduced and the power fed into the 110,000-volt network of the Company. In order to reach the load centers around the San Francisco Bay region it was necessary to construct a new 110,000-volt line from Vaca-Dixon via Cordelia and the famous old Carquinez Straits crossing, to join an existing tower line between Oakland and Newark, the principal distributing substation of the Company located at the south end of San Francisco Bay. Two new receiving substations were simultaneously constructed in Oakland, Claremont on the north and 50th Avenue on the south side, and one in San Francisco near old Martin Substation. From these substations power was fed into the local distribution systems at 11,000 volts.

Vaca-Dixon was planned as a temporary southern terminus of the line, it being intended to later extend the line first to a point just south of the San Joaquin River and finally to Newark or a new station located near Newark, the new route to stay clear of the Bay region where ocean fogs occur. The first extension 29 miles southerly to the new Contra Costa Substation located near Antioch will soon be completed. The type of construction, with the exception of river crossings, is the same as the valley portion of the Pit River line, namely, double-circuit towers on concrete foundations, the conductor being 500,000 circular mil, 49-strand rope lay copper cable, .91 inch in diameter and weighing 1.54 lbs. per lineal foot.

The route selected for the line crosses the Sacramento and San Joaquin Rivers and the fertile Delta lands lying between them. This section of the line required particular attention as it involved the two long-span river crossings together with deep deposits of semi-liquid silt and peat for foundations. The Sacramento River span is 4135 ft. in length and the crossing



The 459-foot tower on the south bank of the Sacramento river (Sherman Island).

is effected by using two towers, one 459 ft. and the other 410 ft. in height, each backed up by an anchor tower 100 ft. high located approximately 2000 ft. away. The San Joaquin River is crossed by using three high towers between the two anchor structures, the middle tower being located on an island in the river. As the spans are shorter (3175 ft. and 2250 ft. respectively) these towers are 269 ft., 359 ft., and 314 ft., in height. The 459-foot tower on the south bank of the Sacramento River is believed to be the highest structure used for supporting a transmission line.



Looking across Sherman Island toward the 459-foot tower.

Before starting final designs on the long spans crossing the San Joaquin and Sacramento Rivers preliminary studies were made of various schemes in order to determine the most economical type of construction. It was first necessary to decide whether the river crossing spans would be taken care of by suspending the special high-strength conductor between the high towers located on each bank, designing these towers to take the dead end pull of all the conductors, or whether greater economy would result if the high towers merely acted as supports for the cables, the tension being taken care of by low anchor towers located some distance back from the high towers. An investigation showed the latter plan to be the better from the standpoints of cost, construction and maintenance, and it was therefore adopted.

With this general plan in mind, estimates were made which give consideration to several different types of cable or conductor, each requiring different heights and strengths of towers. As a result of this study a cable consisting of 19 wires of different sizes was adopted. Thirteen of these are of copperweld or copper-clad steel, giving to the cable its strength, and the remaining six are copper which, in addition to the copper coating of the other strands, give the necessary conductivity. After choosing the design it was next necessary to make tests of the cable to determine its strength and its elastic and thermal properties.



View of the Sacramento-San Joaquin Delta lands from top of the 459-foot tower on Sherman Island.

Studies had meanwhile been made on the type of insulation to be used on both the crossing and anchor towers. Also, the vertical and horizontal separation of wires. together

with the necessary clearances between the wires and the towers, had been selected. The road was therefore cleared for the final design of the structures.

The maximum allowable tension in the cables was set at 20,500 lbs., this is apt to occur under a condition of low temperature, 25° Fahrenheit and an indicated wind velocity of 92 miles per hour. With this basis it was necessary to find what the tension would be on a warm day (125°F.) with no wind blowing, as this condition gives the greatest sag and therefore the least clearance between the wires and the surface of the river below. The permit to construct a span across a navigable river carries with it the proviso that the clearance between the wires and the water surface shall never be less than 125 ft. In view of the possibility of a dam being constructed below here in the not far distant future and of the possible uncertainty of exact knowledge of the elastic properties of this peculiar cable, the designs were based on an assumed minimum clearance between wires and water of 130 ft., slightly more than that required by the permit.

A study of the profile of the ground and the shape or curve that the cable would assume on a very warm day determined the location and height of the towers. At the Sacramento River, for instance, the span between the high towers is 4135 ft. The sag of the wire on a hot day is 256.5 ft. The length of the insulator and bracket is 13 ft. Adding the necessary 130 ft. clearance to these values we find that the lowest cross arm must be located 399.5 ft. above the high water level of the river, which placed the top of the tower 458 ft. above this mark. But the elevation of the tower foundation would be one foot below the high water level, making the total height of the structure 459 ft. which is believed to be a record height for a transmission line tower. These high towers were then designed to safely withstand the following loads:

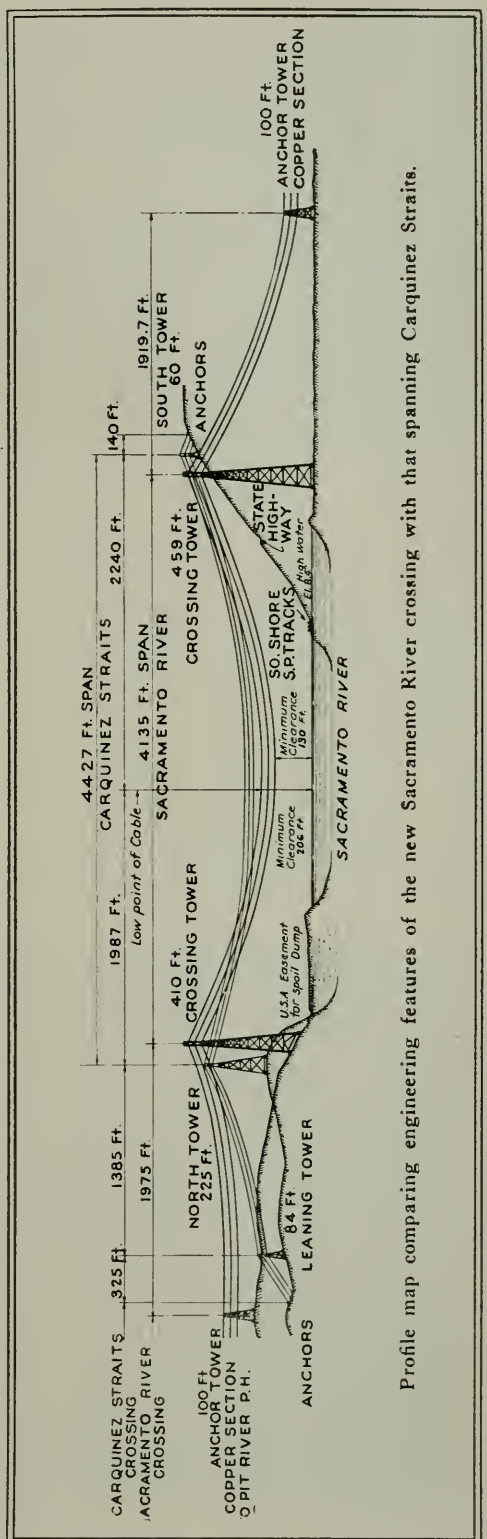
Weight of six wire cables plus insulators= 69,000 lbs.

Weight of tower=405,000 lbs.

Transverse wind on six cables and insulators= 14,400 lbs. (Wind at 45° to line).

Wind load on tower at 20 lbs. per sq. ft.=108,000 lbs. for 459' towers with the wind at 45° to line.

Unbalanced load due to any one wire dead ended at 20,500 lbs. plus an unbalanced load of 1000 lbs. each at the five remaining wires=25,500 lbs.



Profile map comparing engineering features of the new Sacramento River crossing with that spanning Carquinez Straits.

It is interesting to compare the effect of these loads in producing stress in some of the members of the highest tower. The maximum stress in the leg member just below the wires is 122,400 lbs. of which 14 per cent is due to wind on wires and 16 per cent to wind on tower, giving a total of 30 per cent due to wind loads only. When we analyze the stress of 410,000 lbs. in the leg at the bottom of the tower we find that 10 per cent is due to wind on the wires and 40 per cent to wind on the tower only, giving a total of 50 per cent due to wind forces alone. This shows the importance that wind loading plays in structures of this type. The unit wind load considered, namely 20 lbs. per square foot, is the force which would be exerted by a wind blowing 92 miles per hour (indicated velocity). This is 40 per cent in excess of the greatest recorded wind at Sacramento, the nearest Weather Bureau station. Before the elastic limit of any of the members of the structure would be reached, a wind velocity of 123 miles per hour would be attained.

In addition to making the tower adequate for strength it was necessary to provide certain conveniences for making the tower accessible and permit men to work on the cross arms over 400 ft. in the air. The first was accomplished through the medium of a stairway instead of the customary ladder, and the second by making of each cross arm a platform with solid floor and railing. In addition to the three cross arm platforms a fourth was added below the lower arm so that insulators, hardware, etc., could be detached and lowered a short distance to men in close contact with those on the cross arm above.

The foundations for the tower consist of huge concrete blocks supported on wood piling. Nature has made conditions difficult at this site, for we have not finished the job when the tower has been brought down to the surface of the ground. During the many thousands of years preceding the present the Delta lands have been slowly building up with very fine silt and decayed vegetable matter or peat. These have gradually consolidated until they are capable of supporting light loads, but they cannot support the weight of a structure of this sort. It was therefore necessary to drive wood piling under all of the towers erected on the Delta between the Sacramento and the San Joaquin rivers, some of these piles being driven 80 ft. below the ground. The highest tower has foundations containing 268 cubic yards of concrete (1,050,000 lbs.) and is supported on 72 piles each 60 ft. long. To again stress the importance of wind, 66 per cent of these amounts of concrete and piling are required for wind load only.

The shorter anchor towers are designed to withstand not only the weight of tower and cables and wind on tower and cables but also a pull of 20,500 lbs. from each of the conductors. Wind loading, therefore, becomes of secondary importance on this lower tower, as only 10 per cent of the stress in the bottom leg member of the tower and 10 per cent of the load on the foundations is due to loads from this source. The tower weighs 66,000 lbs. and is 100 ft. high. No stairway or other unusual conveniences are provided with this structure which is nearly identical in height with



The 410-foot tower on the north bank of the Sacramento River.

the standard towers of the remainder of the line. Due to the dead end pull from all six wires it was necessary to batter or incline six of the piles under the compression footings until they were placed in position to resist the resultant combined load of the vertical and horizontal forces, thus preventing horizontal movement of the tower under this force which has a total value of over 60 tons.



Transmission line from Contra Costa Substation looking toward Sherman Island.

The attached drawing shows the Sacramento River crossing compared with the famous crossing at Carquinez which for many years held the record for length of span. It will be noted that the 4135 ft. span at the Sacramento River is only slightly less than that at Carquinez, which is 4427 ft.

The cable at Carquinez is of very high strength steel and can be pulled to a greater tension than that used at the new crossing. The effect of this greater tension in permitting lower crossing towers with a higher clearance (206 ft. instead of 130 ft.) above water surface can be noted. However, such a cable would not have the conductivity or the resistance to weathering, corrosion, etc.

It will further be noted that the topographical features of the Carquinez crossing are the more favorable, for due to the elevation of the hill, South Tower with wires actually above those at Sacramento River is only about 60 ft. high. Similar conditions but not so marked occur at North Tower, where a 225-ft. tower places the wires 382 ft. above water surface.

At the present time, all towers have been completely erected and stringing of the cables across the San Joaquin River is under way.



Contra Costa Substation, southern terminus of the 220,000-volt transmission line from Vaca-Dixon.



Views of the 220,000-volt Pit River Transmission system. Upper left, Pit River No. One power house, installed capacity 93,834 horsepower; upper right, single circuit tower with suspension insulators; center left, double circuit tower; center, interconnected network of transmission lines of all voltages, and topography of California; center right, Pit River No. Three power house, installed capacity 108,580 horsepower; lower left, single circuit angle tower, with dead end insulators; lower right, Vaca-Dixon Substation, installed capacity 200,000 horsepower, the principal receiving substation.

The Electric Transmission of Power

Address by J. P. Jollyman, of the Pacific Gas and Electric Company, Before the Faculty and Students of Princeton University, Tuesday, April 13, 1926.

I desire to express my appreciation of the invitation to address you. It is indeed an honor to appear in the hall of one of the oldest and greatest of the Universities,—one which was chartered before the founding of our great republic.

It is my purpose to speak of the Electric Transmission of Power,—its economic importance, its problems and its possibilities.

Economic Value of the Use of Energy

The characteristic which distinguishes the present age from all preceding ages is its greater use of the forces of nature for the benefit of mankind.

The economic surplus resulting from the extensive use of mechanical energy has added to our wealth and to our well-being. It has made possible the extension of better education to the many and has brought within the reach of all our people standards of living which would have been considered impossible even a brief century ago.

The use of animal power to assist man in his work dates back into the ages of which we have no record. The use of water power in the form of the paddle wheel for elevating water has been known in Egypt and in China for thousands of years.

Steam power was introduced at the beginning of the eighteenth century and was used in crude and wasteful forms until 1763, when James Watt invented the devices that make the steam engine economical and generally useful.

By the beginning of the nineteenth century the stationary steam engine was considerably employed. Steam power was applied to transportation through Fulton's steamboat in 1807 and Stevenson's locomotive in 1829. A full century elapsed from the inventions of Watt before a fundamental change was made in the application of steam power.

In 1884 Parsons introduced the steam turbine. Inherently a device requiring a high rotative speed for economical performance, the steam turbine is especially fitted for driving electric generators. From modest beginnings of a few hundred kilowatts, the steam turbine has developed rapidly until units of 50,000 to 60,000 kw. are not uncommon.

Commencing about 1850 water power made great progress. Its use was greatly facilitated by the invention of the Francis type of reaction turbine for low and medium heads by J. B. Francis of Lowell, Mass. in 1849 and by the development of the Pelton type of impulse wheel by Lester Pelton of California in 1880.

The development of water and steam power made possible railroads, steamships and factories. The inconvenience and high cost of steam power in small units practically prohibited its use by individuals and the fact that water power had to be used at its source limited its uses to those who could take their work to the waterfall or the millpond.

Development of Electric Transmission

While the development of the steam engine and of the water wheel were in progress, the discoveries were being made of the fundamentals of the use of electricity for the transmission of power. Commencing about fifty years ago, electricity was first employed for this purpose after having been used for telegraph communication for some twenty-five years. It is not necessary to dwell at length on the rapid extension of the use of electricity for the transmission of energy. All are familiar with the universal use of electricity as a medium for furnishing light, heat and power.

Electricity furnishes the most convenient and economical known form for the transmission of energy. It permits the subdivision of the power of the waterfall or of the giant steam plant into convenient units for the use of the individual or for the use of industry. It is equally capable of lighting a single lamp or an en-

tire city, of operating a sewing machine or a factory, of driving a street car or a heavy train.

Definition of Kilowatt Hour

Before speaking further of this subject it will be well to define the most commonly used unit of energy,—the kilowatt hour. One of the handicaps of our industry has been the necessity of using terms which convey little or no meaning to the average customer. Volts, amperes, power factor and kilowatt hours mean little to him and yet it is the kilowatt hour which he must buy.

We all know that the kilowatt hour is 2,655,000 ft. lb. of energy. It is even more useful to know that it represents an amount of energy greater than any ordinary workman exerts in one day. It represents the amount of energy which would be required to elevate a 165 lb. man 16,000 feet. It would carry him to the top of the Woolworth building 21 times. It is equally important to know that this amount of energy can be purchased for a few cents. If delivered at our home in condition for operating lights or appliances for 5 to 10 cents, if delivered at our shop for 2 to 5 cents and if delivered in large quantities for 1 to 2 cents.

The large power companies receive an average return of about 2 cents per kilowatt hour. At this rate a man may purchase the energy equivalent to a day's work for one-half per cent of the cost of employing a man for a day.

The economic advantage of being able to purchase energy at such a low rate is very great. The material progress of our country in the past few years ceases to be a wonder when the significance of these facts is fully realized.

Progress in the use of electrically transmitted energy has been rapid. The United States as a whole uses about 500 kw.-hrs. per capita, each year, while in California the per capita use is 1500 kw.-hrs. each year. Electricity may be said to furnish the 4,000,000 inhabitants of California with energy equal to that which could be produced by some 13,000,000 men.

Reason for California's Part in Transmission

It will be of interest to explain why California has taken such a prominent part in transmission history.

California's geographic position and topography are partly responsible. Economic conditions contribute. With no coal of high quality and with little coal of any quality fuel has been expensive until oil was developed. Fuel oil has been somewhat uncertain of supply, with a probability of increasing in price. These conditions have led to the extensive developments of water power.

California borders the Pacific Ocean for nearly 900 miles, from the latitude of Savanna to that of Boston. The coast range mountains with elevations generally below 5000 ft. parallel the ocean from Santa Barbara north for nearly 700 miles. The only gap in these mountains is the Golden Gate at San Francisco. Inland lies the great val-



Drum Power House, installed capacity 50,268 horsepower. Transmission voltage 110,000 volts.



Interior of Pit River No. Three Power House, a typical medium head development with hydraulic turbines operating under a head of 315 feet.

ley of California, 400 miles in length and 50 to 75 miles in width. On the east side of the great valley rises the magnificent Sierra Nevada range with summit elevations from 7000 feet upwards to Mt. Whitney whose 14,500 feet mark the highest elevation in United States. The Sierras are a granite range with deep glacial canyons.

At the head of the great valley the granite Sierras join the volcanic Cascade range which extends north into British Columbia. This range contains many splendid volcanic peaks of which Mt. Shasta, 14,380 feet, in northern California, is one of the most impressive.

The only water power sites of importance lie along the streams on the west slope of the Sierras, and on the streams draining the Cascades to the west. Fed by the melting snows of the Sierras and the wonderful springs of the Cascades, these streams descend to the valleys with rapid drops. The water power sites lie from 100 to 300 miles from the valleys and cities where power is most used. By employing long transmissions and the highest practical voltages, it has been found possible to deliver power at the cities at less cost than from fuel burning plants.

Present Status

At the present time it may be said that transmission practice is fairly well standardized for voltages up to and including 150 kv. Thus far the only 220 kv. systems in operation are two in California. One other is now being built in Pennsylvania. This last step forward in transmission voltage has attracted so much attention and holds such possibilities for the future that a consideration of its problems and possibilities will be of interest.

To give these considerations a practical aspect, reference will be made to the Pit River Project for illustrations of the point at issue.

Economic Considerations

The fundamental reason for the rapid increase in transmission is to increase the possible distance of transmission for a given cost or for a given distance to increase the capacity or lessen the cost.

Let us suppose a possible power supply capable of developing power at a low cost 200 to 300 miles distant from a market and let it be assumed that the probable cost of



Interior of Drum Power House, a typical high head development with impulse water wheels, operating under a head of 1375 feet.

transmission will permit it being delivered to the market at a cost that will compare favorably with the cost of power from other sources. What practical problems face the transmission engineer and what possibilities exist.

Theory and experience show that the capacity of an alternating current circuit of a given length increases with the square of the voltage employed, whereas the cost of the circuit increases only about as the first power of its voltage. The higher the voltage that may be employed, the less will be the cost of transmission, provided there is a sufficient load for the circuit.



Interior of Vaca-Dixon Substation. The machine in the foreground is the 40,000 kv-a synchronous condenser, the largest in the world.

For example, a 110 kv. 60 cycle twin circuit line 200 miles in length can carry 30,000 kw. per circuit and will cost about $15,000 per mile. A similar 220 kv. line can carry 120,000 kw. per circuit and will cost about $30,000 per mile. The capacity of the 220 kv. circuit is four times that of the 110 kv. circuit, whereas its cost is only twice as much.

It will be interesting to state the costs for the line alone for each kilowatt hour delivered. Annual costs are about 7 per cent for interest and 4 per cent for depreciation, maintenance and operation,—a total of 11 per cent.

An annual load factor of at least 60 per cent should be obtainable for a long transmission.

200 miles of 110 kv. twin line will cost $3,000,000 and can deliver 330,000,000 kw.-hrs. per year at 62½ per cent load factor with an annual charge of $330,000 or 1 mil per kw.-hr.

200 miles of 220 kv. twin line will cost $6,000,000 and can deliver 1,320,000,000 kw.-hrs. per year at 62½ per cent load factor with an annual charge of $660,000 or ½ mil per kilowatt hour. The costs of the necessary receiving and regulating substations will increase these costs considerably but in about the same proportion. The superior economy of the highest practicable voltage is apparent if large amounts of power are to be transmitted.



Claremont Substation, connecting the 110,000 volt transmission system with the 11,000 volt distribution system at Oakland.

Having determined that 220 kv. is economically desirable let us review the problems that must be faced.

1—Insulation

The first problem to consider is that of line insulation. A 200 mile line will have about 1400 points of support with not less than 6 times as many complete insulators, probably 9,000 to 10,000 in all. Only a few switch and transformer bushings will be required, hence their cost will not be a material factor even though their unit cost is high.

The only line insulators available today for the highest voltage lines are the suspension types composed of a number of comparatively small units flexibly coupled together and capable of resisting tension only. This type of insulator was introduced in 1907 and was first described before the A. I. E. E. by E. M. Hewlett.

The standard unit as now manufactured has a diameter of 10 inches, a dry flashover value of 85 kv., a wet flashover value under conditions simulating heavy rain of 50 kv. and a flashover value of about 25 kv. when covered with dirt and wet with fog or a heavy dew. Experience has shown that a string should be 35 to 40 inches long for 110 kv. operation and proportionately longer for higher voltages.

Many practical problems have been encountered in the design and manufacture of suspension insulators. Porcelain is the most suitable material commercially available.

Coupling the porcelain units together so as to develop a reasonable mechanical strength has been a problem because porcelain is less elastic and has a lower thermal coefficient of expansion than metal. Strangely, the most successful method thus far produced consists in cementing the porcelain parts into metal caps and pins.

Another difficulty attendant on the use of many units in a string is the fact that the units do not take their proper share of the electrical load. The units act as condensers in series, but have capacity to the tower and to earth as well as to each other. The result is that the unit next to the conductor takes much more than the average stress, the next unit somewhat less and so on up the string until the second or third unit from the tower arm is reached where the stress is a minimum. (*See Fig. 1*). On

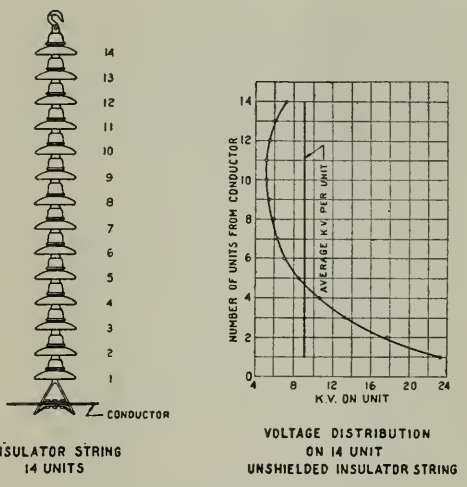


Fig. 1

a wet string, surface leakage currents may much exceed charging currents and be largely instrumental in determining the distribution of voltage. Experience indicates that the condition most likely to give trouble is dirt and fog or dew.

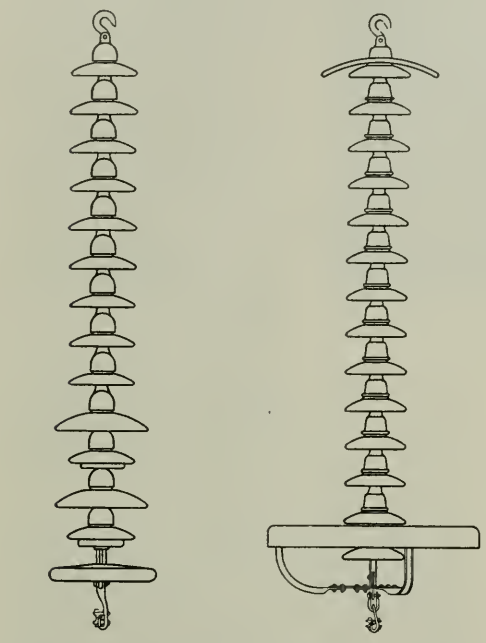
On high voltage lines occasional flashovers of insulator strings occur due to lightning, birds, to dirt and fog and possibly to other causes not fully understood. Whatever the cause, the resulting arc, if allowed to continue for more than about one second, may strip all the insulators or damage the conductor or both. The only sure way to suppress the arc is to take the line out of service.

Several devices for improving the performance of the insulator string and protecting it against damage from arcing have been developed and applied.

The arcing and grading ring is used. This consists of a ring about 2 feet in diameter surrounding the insulator unit nearest the line. It improves the distribution of voltage on the several units of the string and protects the lower part of the string from damage due to arcing. Its disadvantage is that it reduces the arcover value of the insulator slightly and reduces the distance from the live parts to the tower.

Another device is the corona shield which consists of a conducting surface shaped like an insulator with a well rounded edge mounted below the insulators but above the conductor. It retains or increases the flashover value of the string and suppresses

the tendency for discharge from the conductor or suspension clamp near the insulator but has little effect on the grading of the string. It seems to have proven about equally satisfactory in service compared with the grading ring. (*See Fig. 2*).



INSULATOR STRING WITH CORONA SHIELD

INSULATOR STRING WITH RING SHIELD AND ARCING HORN

Fig. 2

The fundamental weakness of the multipart suspension insulator in its present form is the fact that the electrical strength of any unit is much below the total voltage applied, and no positive means exist for controlling the distribution of this voltage among the several units.

For parts requiring rigid support pillar type insulators are available consisting of several multipart units. These units individually have much higher flashover values than the suspension units. A typical flashover value is 185 kv. dry and 145 kv. wet. Observation indicates better performance of these insulators in a given length than of the standard suspension units.

2—Corona

Another important practical problem is the selection of a size of conductor that will avoid excessive energy loss into the air by reason of the electrical overstress of the air surrounding the conductor. This phenomena called corona has been recognized for many years and has been the subject of considerable study. After a careful study of the matter and considerable experimentation, a law of corona loss was proposed a few years past. Recent tests on actual lines indicate that the proposed law of corona loss does not contain all the factors that it should. The corona losses measured on some lines of considerable length do not seem to follow the form of law proposed. It is to be regretted that much experimental effort has been directed towards obtaining corona losses far above the values that could be considered commercially, while a complete determination of the law of loss in the commercial range has not been made.

An intensive investigation of this subject is being planned for the near future by a Pacific Coast university, assisted by the transmission companies.

Fortunately, the size of conductor that is economical from other standpoints avoids a corona loss that is uncommercially high. For 220 kv. the conductors must be .9 inch to 1.0 inch in diameter and even with this size conductor the corona loss will be 7.5 to 10 kw. per mile of circuit. An idea of the narrow margin on which we are working can be had from a consideration of the fact that the loss increases to 75 kw. per mile at 260 kv.

The mechanism of this loss is not fully understood but is being studied by some very able men.

3—Voltage Control

A third major transmission problem is that of voltage control.

It is hardly necessary to consider the fundamental properties of an electric circuit transmitting an alternating current. We are all familiar with the fact that a part of the voltage applied is consumed by the circuit. The three basic voltages, which are the voltage applied, the voltage consumed by the line and the voltage delivered are related vectorially but not arithmetically.

The vector relation of the voltage consumed by the line to the voltage impressed, depends upon the amount of current transmitted and on the power factor of that current. The difference between the im-

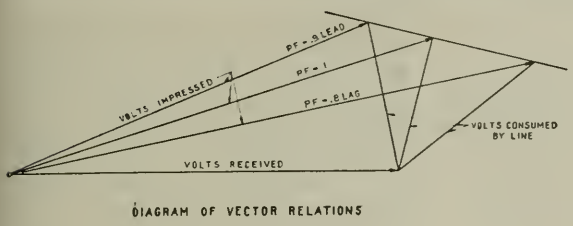


DIAGRAM OF VECTOR RELATIONS

Fig. 3

pressed and delivered voltage is therefore dependent on the amount and the power factor of the load. If the load is large and the power factor is lagging as is usually the case in commercial loads the impressed voltage must be greater than the voltage delivered.

However, as the power factor of the load is brought up to unity the difference between impressed and delivered voltage becomes less and if the power factor can be made to lead a proper amount the impressed and delivered voltages may be equal.

For example, consider the case of a 200 mile 220 volt circuit. At 120,000 kw. load at .8 lagging power factor the impressed voltage would have to be 132 per cent of the delivered voltage, at 1.00 power factor 111 per cent and at 96 per cent leading power factor the impressed voltage would be the same as the voltage delivered. (*See Fig. 3*).

Practically, the voltage of a long transmission system must remain steady at both sending and receiving ends, irrespective of variations in the load and in the power factor of the load.

This result is attained by the use of synchronous condensers at the receiving end of the line, whose function it is to alter the power factor of the load and thereby control the voltage drop over the line. At light loads the power factor may be made more lagging and at heavy loads more leading than would otherwise be the case.

The function of the synchronous condenser may be illustrated by a mechanical analogy. Consider a shaft projecting beyond the last bearing and driving a device from a pulley on the overhanging end of the shaft. The amount of power the shaft may transmit is limited by both the torsional strength of the shaft and by its bending strength. If an outboard bearing be placed on the shaft next to the pulley, the shaft may be relieved of the bending stresses and a greater load can be transmitted.

The synchronous condenser is a sort of an electrical outboard bearing for a transmission system.

Some notable installations of synchronous condensers for voltage regulation may be found on the Pacific Coast. The Southern California Edison Company has 180,000 kv.-a of condenser capacity in the Eagle Rock and Laguna Bell receiving substations of its 220 kv. line and the Pacific Gas and Electric Company has 80,000 kv.-a in its Vaca-Dixon Substation and 40,000 kv.-a additional in other nearby substations.

The modern synchronous condenser is an interesting illustration of the ease with which electrical apparatus may be designed to meet special conditions. Economy requires a given effect with a minimum of energy losses and at a low cost. These requirements are met by using high rotative speeds which give low cost and great refinements of design to give low losses. Starting is accomplished by the use of amortisseur windings in the revolving poles and with a starting voltage about one-third normal. The kv.-a to start a large condenser is one-fourth to one-third the full kv.-a. It speaks well for the progress of the industry that a 40,000 kv.-a unit can be brought from standstill to 600 r.p.m. with no more difficulty than a small motor.

4—Circuit Capacity

A fourth problem relating to the engineering of long high voltage lines is the determination of the maximum load that can be carried. A transmission circuit has a maximum load capacity just as a bridge or any other engineering structure has a maximum load capacity. This problem has only recently become of importance because with short lines considerations of economy of losses has limited the loads to values much below the maximum possible values. On any circuit the maximum load is reached when additional load current causes an actual decrease in the kilowatts that a circuit can deliver.

When such a condition has been reached the generating equipment looses synchronism with the load. An imperfect analogy would be a shaft loaded to a point where

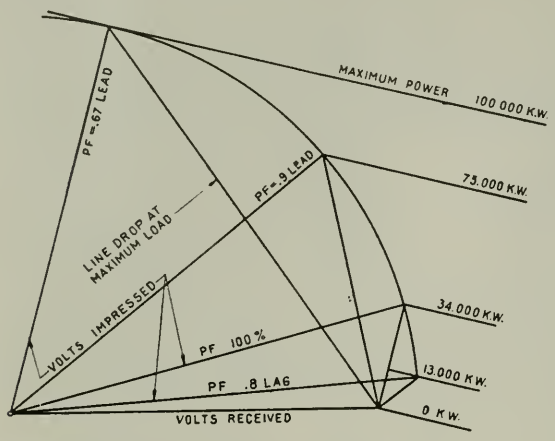


DIAGRAM OF MAXIMUM POWER-STEADY STATE

Fig. 4.

it was ruptured by torsion. For a line of a given length the limiting load is affected by the frequency. A 60-cycle line has a much lower load limit than a 25-cycle line. (*See Fig. 4*).

It does not necessarily follow that 25 cycles is more suitable for transmission purposes than 60 cycles. 60-cycle equipment is less expensive than 25-cycle equipment. 60 cycles is distinctly preferable for incandescent lighting.

The question of circuit capacity has attracted much attention in the past year or two. It has been studied by able engineers from every standpoint. Tests have been made with laboratory models of transmission systems and recently a series of tests were made in co-operation with one of the large manufacturers on the system with which I am connected.

Our previous operating experience had given us a fairly good idea of the results that might be expected and I am pleased to say that out anticipations were confirmed.

As in the case of a bridge, there are two load capacities,—first a maximum steady load that can be carried up to the point of failure, and second, a distinctly smaller load that can be carried with safety and with due regard to the fact that actual loads contain an element of impact which must be allowed for in establishing the actual load that may be safely carried.

The Pit transmission may be taken as an example. The maximum steady load for the circuit alone is 240,000 kw. per circuit. The safe limit is in the neighborhood of 150,000 kw., because the operation of a system is certain to impose momentary additional loads due to disturbances arising from the switching of branch lines in or out of momentary reductions in voltage from grounds or short circuits on lines fed from the main transmission.

It will be interesting to consider whether the load capacity of such a transmission line represents a load that can be carried with economy of cost.

The total cost of transmitting energy over a line is made up of two factors:

First—The fixed charges on the investment which are interest, depreciation and operation. These may be taken at about 11 per cent for a steel tower line in California.

Second—The value of the energy lost in transmission due to I^2R losses and to corona losses.

As the load increases the cost per kilowatt hour delivered for fixed charges decreases but the value of the lost power increases. The total cost per kilowatt hour starts at infinity for no load and decreases rapidly as the load increases.

The effect of the value of lost power soon becomes noticeable, a minimum is reached and costs begin to increase due to the fact that the cost of losses increases more rapidly than the cost of fixed charges decreases. For a typical 110 kv. line 50 miles in length the minimum cost is reached at 45,000 kw. per circuit. (*See Fig. 5 on following page*).

This determination of minimum cost is simply an application of Kelvin's law. In using this law the cost curve should be drawn rather than solving the equation for the minimum because the curve is often quite flat near the minimum. Not infrequently large savings of first cost are possible with a small increase in annual cost.

The engineer must realize that the raising of funds for a project is quite as much a problem as are the technical problems and that a slightly higher operating cost is often to be preferred to very high fixed charges. With a given transmission line it may be better to increase the load beyond the economical point than to incur the large expenditure of capital for a second line.

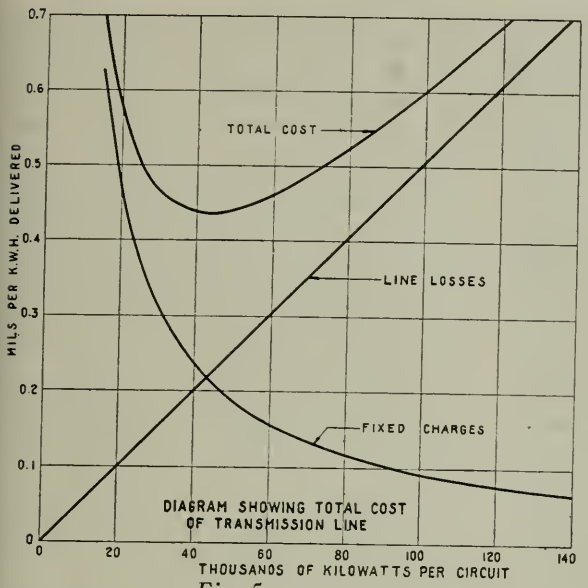


Fig. 5

Operation

The problems of operation must be considered in the design of a transmission system. Aside from isolated cases of direct current supply in the business districts of large cities protected by storage batteries, electrical energy must be generated, transmitted and distributed continuously and in precisely the amounts required by the customers. No other business is quite so exacting.

Water may be stored in reservoirs even though the distributing pipes should always be full. Gas may be stored in holders sufficient for several hours' supply. Electricity must be generated as used. Additional generators must be brought up to the exact speed and voltage of the system before they may be synchronized.

Absolute continuity of service is impossible on any high voltage transmission line. Insulator failures may occur due to lightning or other causes. Testing, cleaning and ultimate replacement of insulators is necessary.

Oil Circuit Breakers

Circuit breakers are necessary to permit opening the circuit under normal or emergency operating conditions.

The design of circuit breakers which can be relied upon on all occasions is a difficult problem not yet fully solved. Progress thus far has centered itself in the air circuit breaker for direct current circuits and in the oil circuit breaker for alternating current circuits.

The action of the oil circuit breaker is most interesting. Upon separation of the contacts, current continues to flow until the current reaches the zero of the alternating current wave.

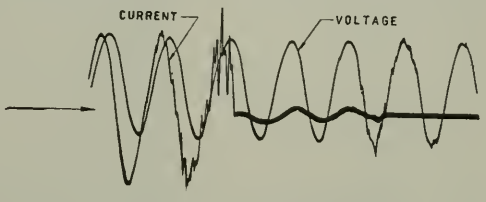
If sufficient opening between the contacts has been attained to prevent the voltage from jumping across the contacts, the circuit will be opened, otherwise, an arc may again be established to continue until the current again reaches zero. (*See Fig. 6*).

While of high insulating value the oil is combustible and breaks down into fixed gases when subject to high temperatures.

These gases mix with the air in the switch tanks and occasionally become ignited and may cause explosions. Continuity of service on a transmission system depends on the ability to disconnect any part which may have become faulty in the shortest possible length of time. In many cases the permissible time is less than one second. It has been found impossible for the most skilfull and alert operator to determine with certainty and disconnect a piece of equipment that is in trouble within the permissible time. Automatic relays have therefore been developed for this work. While far from being perfect and capable of much development, the modern types of relays are performing a very useful function in the operation of transmission systems.

Supply of Charging Current

Another problem which becomes of importance in connection with long high voltage lines is concerned with the supply of charging current. Charging current, which



220 K.V. OIL CIRCUIT BREAKER
OPENING 200 AMP.

Fig. 6

is the current drawn by the line as a condenser, has almost zero leading power factor. When such current is drawn from an alternating current generator, the terminal voltage rises to a higher value than would be the case if the same amount of current at unity power factor were drawn from the same generator.

The charging current of a 200 mile 60-cycle circuit with 220 kv. is nearly 50,000 kv.-a. To bring such a circuit up to voltage, therefore, requires generating equipment capable of supplying this amount of kv.-a at nearly zero leading power factor. Under the conditions it is difficult to hold two or more generators in synchronism. The most convenient method is to use a large generator on the sending end and the necessary amount of synchronous condenser capacity at the receiving end. For example, a 35,000 kv.-a or a 27,000 kv.-a generator may be used with a 40,000 kv.-a synchronous condenser, or with two 20,000 kv.-a condensers.

The sizes of the equipment required for use on such a transmission give an idea of the magnitude of a long high voltage transmission system. It is an economical tool for a big job. Its high cost prohibits its use for a small job.

Future Possibilities

It will be interesting to consider what the future seems to hold for electric transmission. Broadly speaking, it seems certain that it will continue to grow rapidly for many years or until each inhabitant is supplied with the maximum amount of energy that he can economically use.

The question may be asked what will be the next step toward a higher transmission voltage and when will it be taken? This question I cannot answer. I can, however, point out some of the problems that must receive much study before a higher voltage can be undertaken with any prospect of commercial success. Roughly speaking, each major step in transmission has doubled the transmission capacity for a given distance. Thus 150 kv. gave double the capacity of 110 kv. and 220 kv. gives twice the capacity of 150 kv.

To double the capacity of 220 kv. requires 310 kv. Generally accepted conventions would indicate that 330 kv. might be the next step. Such a circuit would have a capacity of some 300,000 kw. for a 200 mile circuit. This is a very large amount of power. It exceeds the amount of power used by any city except a very few of the largest. If used for general distribution an interruption would inconvenience a million people. It seems to have too great a capacity for present requirements.

Before 330 kv. could be undertaken with any probability of success, line insulators would have to be studied and tried on a trial line. It is not impossible that new types would have to be developed.

The laws of corona loss will require further study with conductors of the sizes probably required.

Voltage control will be difficult because the charging kv.-a will be very high. Generator and synchronous condenser capacity will have to be of the order of 50,000 to 100,000 kv.-a.

Oil circuit breakers may have to be developed along radically different lines than have thus far been employed.

I do not say that these things cannot or will not be done. I merely wish to emphasize the thought that voltages higher than 220 kv. should not be attempted until further experience with 220 kv. has been had, and much research work has been done.

Distance of Transmission

To what distance may electric power be transmitted?

The limit of distance today is determined by economic considerations rather than by technical difficulties. Large amounts of power are being transmitted 250 to 300 miles using 220 kv. part or all the way. The longest transmission with no intermediate power supply, of which I have knowledge, is that of the Southern Sierras Power Company from Bishop, California, to Yuma, Arizona, 472 miles at 90 kv. The most remote points normally operated in synchronism on the system of the Pacific Gas and Electric Company and the connecting companies are Independence, Oregon and King City, California,—812 miles apart.

It should be understood that power is not transmitted the 812 miles. Little if any power in this network is transmitted over 300 miles. These long transmissions are economical only where unusual conditions obtain, as on the Pacific Coast.

Electric power is like other commodities. The distance it may be transmitted is measured by the difference between the cost of production and the value at a market.

"Pacific Service" As a Co-operative Enterprise---Melones Power Project

In the month of January, 1925, the Pacific Gas & Electric Company and the Sierra & San Francisco Power Company, whose properties our company operates under lease, entered into an agreement with the Oakdale and South San Joaquin Irrigation Districts by which our company and its associate undertook to co-operate with the irrigation districts mentioned in a construction project of immense importance to the agricultural development of a large section of the San Joaquin Valley.

The lack of sufficient impounded water to encourage proper agricultural expansion had long been a serious handicap to the territory supported by the Stanislaus river watershed, and ever since 1916, realizing the need of greater storage to provide late summer and fall irrigation, the officials of the South San Joaquin and Oakdale Irrigation Districts had been engaged in making studies of various reservoir sites. The final selection was made at the head of Iron Canyon, some few miles below the town of Melones, where the Stanislaus river forms a natural gorge. It was decided to dam the river at that point with a concrete arch-type structure 185 feet high above the stream bed and 590 feet long on the crest and thereby create a reservoir stretching back some twelve miles above the dam and of an estimated capacity of 112,500 feet.

Concurrent to the storage of water for irrigation purposes, the development of the hydraulic energy of the project became an important issue, for rural electrification is playing a more and more important part every day in the development of the great tracts of valley lands that stretch from north to south of our Golden State. Here it was that "Pacific Service" came in with a proposal to make common cause with the irrigation districts for the general good. Negotations were entered into for the sale of the water impounded by the Melones dam for power purposes. In other words, the parties entered into a combined irrigation and power project, a mutual enterprise to the economic advantage of both parties involved as well as to the general benefit of the communities interested.

The entire project under the agreement referred to called for an initial expenditure of approximately $5,000,000. The dam now under construction was financed by a bond issue of $2,000,000 voted by the two districts; its construction cost, however, will ultimately be refunded to the districts inasmuch as the power companies have agreed to pay for the privilege of using the water passing through the dam for power purposes an amount totaling $5,175,000 in semi-annual installments of $64,687.50 each, which, it is calculated, will be sufficient to pay the interest on the water bonds and amortize the issue in forty years. Then, after the power companies have completed the stipulated payments, the maintenance cost of the dam will be shared alike by all parties concerned.



The Melones dam in course of construction.

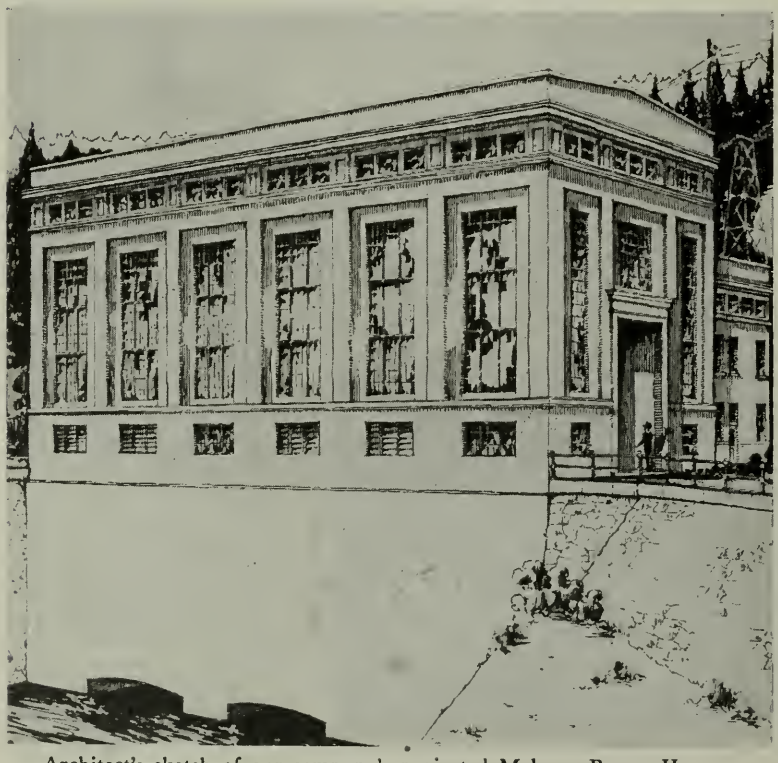
Under the terms of the agreement the districts will have control of the water from March 1st to November 1st of each year, while the power companies will control the outflow for the remainder of the year, except that

enough water must be allowed the districts to fill Woodward reservoir, their principal source of water supply, and meet the occasional demands of the irrigationists in the section affected.

In addition to the dam, the construction work undertaken by the districts includes a 400-foot tunnel leading from the dam to the irrigation outlet. From this point the power companies have undertaken to construct a concrete lined pressure tunnel approximately 4,400 feet in length from the irrigation outlet below the dam to the site of a power house on the river bank, where there is a total head of 235 feet, which, taken with a maximum flow of 1500 cubic feet per second through the tunnel, will enable an electrical generating installation of a total installed capacity of, in round numbers, 36,000 horsepower. From the point above the power house two penstocks approximately 8 feet 6 inches in diameter and 150 feet long will carry the water down the slope to turn the wheels of the power house.

The power house, according to plans now definitely approved, will consist of a concrete and steel structure 110 feet long by 45 feet deep by 50 feet in height, with a switch house in the rear approximately 23 feet long by 110 feet deep by 30 feet high. The design of the power house is similar in character to that at Pit River No. Three Development, which was put in operation a year ago. The principal items of power house equipment will include: two vertical shaft turbines with a maximum capacity of 17,000 horsepower each; two vertical shaft generators with directly connected exciters; one spare motor generator exciter set; two generator oil switches and one stationary oil switch; one switchboard for control of the equipment; one bank of four 12,000-horsepower transformers capable of stepping down the energy from the generating figure of 11,000 volts to the line voltage of 115,000; one 115,000-volt oil switch for control of the line between Melones and Manteca, where the Pacific Gas and Electric Company operates the most important substation in the Oakdale and South San Joaquin end of the San Joaquin Valley.

The main transformers, 115,000-volt oil switch and high tension switching equipment will be mounted outdoors, while all other equipment will be indoors.



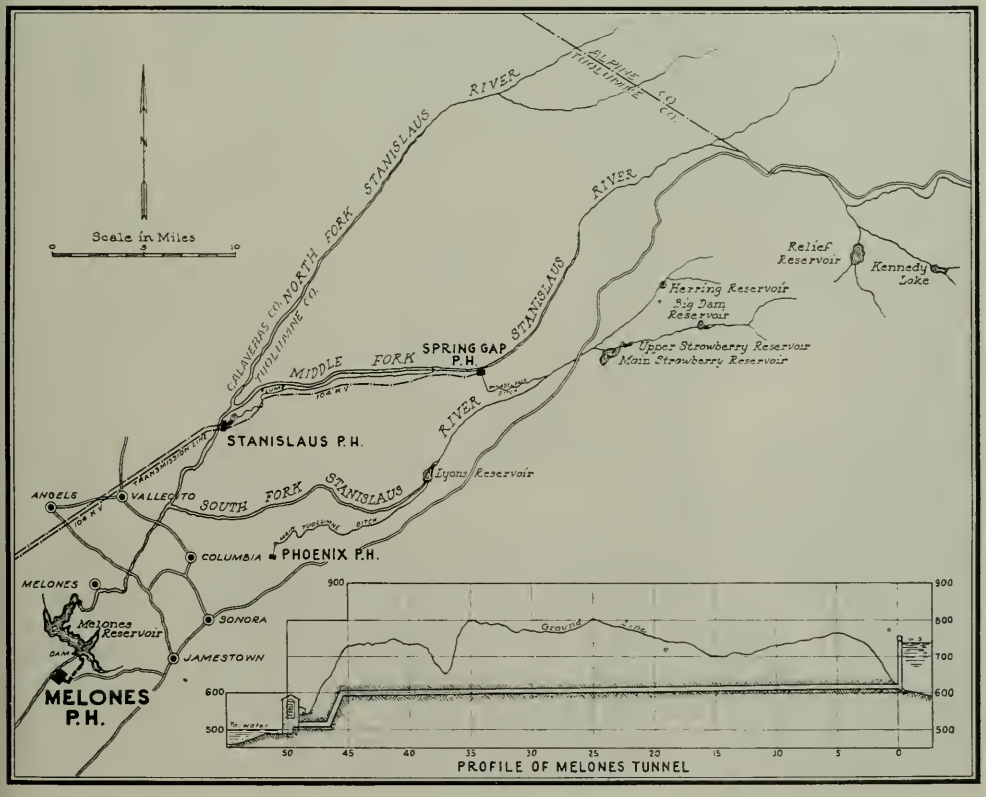
Architect's sketch of our company's projected Melones Power House.

In the way of long distance transmission, the lines from the new plant will tie in with our company's main transmission system at Copperopolis, seven and one-half miles away. The water used for power will be returned to the Stanislaus river, below the power house to flow to Goodwin dam, some eight miles down stream where it will be distri-

buted to irrigation districts through the district's canals. By this arrangement irrigationists will benefit from the water stored immediately behind the Melones dam and also may profit from storage in the reservoirs of the Sierra and San Francisco Power Company at Strawberry and Relief, in the high lands above Sonora.

The Pacific Gas and Electric Company's construction crews moved in on the job in November last year. At the time of writing 2500 feet of tunnel has been excavated. In order to utilize a single construction plant and organization for the major part of this work, an adit 200 feet in length was driven from the river canyon to the central line of the tunnel, and from this central point headings were started toward the dam and the power house on a two-shift basis, one drilling and one mucking crew working alternately at each heading. For each 9 feet round in the full heading, 36 holes are drilled from a drill carriage supporting six rock drills. In each shift of 8 hours the drilling crew loads and fires a full round, breaking up 9 feet of solid rock. On the following 8-hour shift a small crew, using a Conway mucking machine electrically operated, loads the loose rock into cars which are hauled from the tunnel to a waste dump in the river canyon. By this arrangement an average progress of 9 feet at each end, or 18 feet in all, per day has been consistently maintained.

The work of excavating the foundations for the power house started in the early spring of this year. At the time of writing it is about three-fourths done and it is expected will be completed next month. It is planned to have the entire tunnel and power house completed by June 1st of next year, at which time water will flow from the reservoir to the power plant and thence to the lands of the Oakdale and South San Joaquin districts for irrigation purposes.



Map of our company's hydro-electric development under construction on the Stanislaus river below Melones dam.



The "Pacific Service" honor roll. The above portraits are of eight former employes whose long and faithful service has earned them honorable retirement.

The "Pacific Service" Roll of Honor

Heading the honor roll of "Pacific Service" are 81 names of men whose long and faithful service to our company has been rewarded by their honorable retirement with provision for their declining years under our company's pension system, which underwent complete revision in the fall of 1921.

In preceding issues we presented the portraits of men whose names are upon our company's pension roll, accompanied by their several service records. In doing this we were actuated by a desire to make our readers acquainted with these men and their records and to point out what is generally recognized in all up-to-date business enterprise, namely, that long and faithful service shall have its reward.

Opposite this will be found another installment of eight portraits of our company's pensioners. These are:

John Keenan. 70 years of age, having been born June 22, 1856. Entered the service of the San Francisco Gas Light Company in May, 1876, and at the time of retirement on a pension, March 1, 1925, was employed in San Francisco Division.

Granville C. Snider. 67 years of age, having been born May 8, 1859. Entered the service of the Central Street Railway Company, Sacramento, in April, 1889, and at the time of retiring on a pension, January 1, 1926, was employed in Sacramento Division.

James McKay. 68 years of age, having been born November 16, 1857. Entered the service of the San Francisco Gas Light Company in September, 1890, and at the time of retiring on a pension January 1, 1925, was employed in San Francisco Division.

Thomas L. Elliott. 68 years of age, having been born March 22, 1858. Entered the service of the Central Street Railway Company, Sacramento, in April, 1891, and at the time of retiring on a pension, March 1, 1925, was employed in Sacramento Division.

Patrick Rodden. 67 years of age, having been born September 9, 1859. Entered the service of the San Francisco Gas Light Company in September, 1881, and at the time of retiring on a pension, May 1, 1926, was employed in San Francisco Division.

Michael Gorman. 66 years of age, having been born in 1860. Entered the service of the San Francisco Gas Light Company in November, 1883, and at the time of retiring on a pension, May 1, 1926, was employed in San Francisco Division.

Thomas Fraser. 65 years of age, having been born February 22, 1861. Entered the service of the Pacific Gas Improvement Company in 1884, and at the time of retiring on a pension, May 1, 1926, was employed in San Francisco Division.

August Anderson. 67 years of age, having been born December 15, 1858. Entered the service of the Central Light and Power Company in 1897, and at the time of retiring on a pension, January 1, 1925, was employed in San Francisco Division.

The Financial Side of "Pacific Service"

Following is a condensed preliminary statement of the Company's earnings for the first six months of 1926, compared with the same period of last year:

	6 Mos. Ended June 30, 1926	6 Mos. Ended June 30, 1925	Increase
Gross revenue, including miscellaneous income	$24,999,412.45	$23,917,114.27	$1,082,298.18
Operating expenses	14,921,380.68	14,199,405.65	721,975.03
Balance for fixed charges, depreciation and surplus	$10,078,031.77	$ 9,717,708.62	$ 360,323.15

The addition of $1,082,298 to the Company's gross revenue reflects a very satisfactory increase in volume of business, particularly in view of the reductions in gas rates which were made effective on October 22nd and November 26th, 1925, respectively. These reductions, by which our customers were given the benefit of lower prices for fuel oil used in gas manufacture, were offset by a corresponding decrease in the Company's operating expenses, but nevertheless diminished its gross revenue by about $800,000. Except for these reduced gas rates, the increase in gross in the first half of 1926 would have approximated $1,880,000.

In the first six months of the current year, the net addition of consumers was 25,292, including those added through the acquisition of the Sacramento Gas Company. New customers added through the normal growth of business numbered 18,492, or 4,171 more than in the same period last year. The total number of active meters in service at June 30, 1926, was 838,990.

ACQUISITION OF SACRAMENTO GAS COMPANY

Negotiations have recently been completed for the purchase of the Sacramento Gas Company, which furnished gas service to approximately 7,500 customers in Sacramento, the capital of the State, and about 1,000 consumers in Lodi, California. The acquisition of this Company was a logical development of our operations, and affords an excellent opportunity for increased business and an improved standard of service in both of these cities, which are now supplied with gas service exclusively by this Company.

The Sacramento Gas Company at the time of its acquisition had total assets, as shown by its balance sheet, of $1,463,887. There were outstanding $546,400 of First Mortgage 6% Bonds, which have been called for payment on October 1st, 1926; and $429,100 par value of stock, of which 97% is owned by your Company. Annual gross revenues were approximately $360,000.

DISTRIBUTION OF OWNERSHIP OF GAS AND ELECTRIC COMPANIES IN CALIFORNIA

This Company has just completed a canvass of the distribution of ownership of the stock of California gas and electric companies. Statistics secured from the twelve largest utilities in the State furnishing these services to the public show as of June 1, 1926:

		% of Total
Stock owned in California	$237,462,900	63.6%
Stock owned outside of California	136,107,600	36.4%
Total Outstanding Stock Capitalization	$373,570,500	100.0%

At the date mentioned, these twelve companies had 195,936 stockholders, of whom 173,049, or 88.3%, were California residents. Only 22,887 stockholders, or 11.7% of the total, appeared as non-residents of the State.

The preferred stocks of these companies are especially popular in this State, 134,-110, or 91.1% of all preferred stockholders being local residents, while those holding common stock total 38,939, or 79.9% of the holders of this class of security. Holdings in California average 12.7 shares per stockholder.

In local ownership, the Pacific Gas and Electric Company heads the list with $77,-977,100 of its stock held in the State. This is more than 70% of its total outstanding stock and is about one-third of all the stocks of these twelve companies owned by California people.

These figures speak eloquently of the extent to which the people of this State have invested their savings in the securities of local utilities, but tell only a part of the story as they do not include many millions of dollars of bonds held by California investors.

AMERICA'S FAVORITE INVESTMENTS

PACIFIC GAS AND ELECTRIC COMPANY SECURITIES ARE AMONG THE MOST POPULAR UTILITY ISSUES IN THE COUNTRY

In the summer of 1925, Barron's, a nationally known financial publication, offered prizes for the best plans for investing $100,000 which was to be treated as the whole fortune of a widow with two young children.

Approximately 1,500 manuscripts were received, of which 1,110 were thought worthy of serious consideration.

The prize-winning articles and an analysis summarizing the recommendations of all of the 1,110 worth-while papers submitted were recently published in book form under the title "Investing for a Widow." The companies in which investment is suggested are listed in the order of their popularity, and it is significant to note that *the securities of the Pacific Gas and Electric Company were selected by more persons than any other similar utility in America,* 265 individuals, or practically one-fourth of all those whose articles were considered, including some of this Company's issues in their investment lists.

The ranking of the fourteen favorite companies, as measured by the number of lists on which their securities appeared (bonds and stocks combined) was as follows:

COMPANY	NO. OF LISTS ON WHICH SECURITIES APPEARED
1. American Telephone	668
2. U. S. Gov't. bonds (all issues)	556
3. United States Steel	521
4. Atchison, Top. & S. F. R. R.	416
5. New York Central R. R.	368
6. Baltimore & Ohio R. R.	312
7. Pennsylvania R. R.	298
8. Union Pacific R. R.	290
9. PACIFIC GAS & ELECTRIC	265
10. Westinghouse El. & Mfg.	232
11. Consolidated Gas of N. Y.	220
12. Illinois Central R. R.	213
13. Southern Pacific R. R.	208
14. American Smelting & Refining	199

The Company's General and Refunding 5% bonds ranked sixth in popularity among all bond issues of every kind in the United States. In the public utility field, its common stock was exceeded in the number of selections by the common stocks of only two other gas or electric companies, and on the basis of present market prices offers a higher yield to the investor than either of these two issues.

When one considers that these selections were carefully compiled by experienced and thoughtful investors throughout the country, the great majority of them residing outside of the Company's field of operations, this popularity of Pacific Gas and Electric Company securities is especially gratifying.

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVI JULY, 1926 NO. 9

"Your industry has been the pioneer in public relations. You have established a bond of fellowship between the electric public utilities and their customers in which you can take commendable pride. Few contributions have been made by American business toward the upbuilding and better understanding of general industrial problems to rival those made by the electric light and power companies of the country.

"The two most important elements of good public relations are excellent service and public appreciation. You have pursued the matter of public relations with greater intensity and better understanding year after year.

"By and large, your service has been so excellent and its cost so trifling that considering the tremendous advantages it offers to the manufacturer, the merchant and the householder, almost all of your activities have been regarded with public favor and approval. This is a tremendous asset to any industry."

The quoted words are from an address before the recent convention of the National Electric Light Association in Atlantic City by Mr. J. F. Shaughnessy, First Vice-President of the National Association of Railroad and Utility Commissioners. Himself a man of wide experience, for he served as a member of the Public Service Commission of Nevada for nineteen years and all this time viewing the public service from the standpoint of one of a regulatory body having its conduct and operation under official supervision, no man should be better qualified to analyze fairly and dispassionately the relations between the public utilities and the public they serve. It is with pardonable pride that we lay before our readers the observations of men like Mr. Shaughnessy. They are illustrative of something that only a few years ago appeared before the mental vision of the public utility men of this country as a dimly outlined goal that might or might not be reached after ages of patient striving. Today this goal is no longer dim; that it is drawing nearer and nearer is evidenced by the almost universal change in public attitude and public expression between then and now.

The definite importance of *service* as the only sound foundation upon which to establish relations of mutual confidence and understanding between public utilities and the public has been recognized generally by public utility men throughout the country. In all public service corporations and all organizations of men and institutions connected with the public service the department of public relations is one of the most comprehensive in its personnel and far-reaching in its activities of all the component parts of the working organization. The problem of public relations is a subject of discussion of the first importance in gatherings like the one previously referred to and, also, in the various geographical divisions of this, the N.E.L.A., the greatest association of its kind in the known world today. Special sessions are devoted to the consideration of that problem. Leading men of affairs in every branch of world activity are invited to address those sessions. The scope of inquiry is ever widening, new points of attack are constantly being discovered. And, with the problem of public relations that of service is indisputably allied.

During the first week in June the Pacific Coast Electrical Association held its tenth annual convention in Los Angeles. The brightest lights of the electrical industry on the Western rim of this great continent were there with earnest purpose. The president-elect of the parent body, Mr. R. F. Pack of Minneapolis, made the journey to the coast for the purpose of greeting our Western fraternity and impressing upon us his views concerning the live questions of the day. It was not surprising, then, to hear Mr. Pack devote the greater part of his address before the convention to a discussion of the study of satisfactory public

relations and the best practical methods for their establishment. In the course of his address Mr. Pack said:

"I will take second place to no man in the importance with which I regard public relations, but I do not believe that public relations activities should be a thing separate and apart from the daily life and routine of our companies. Good public relations should constitute the spirit of the entire organization and should represent the soul and personality of our companies."

Another speaker on the same subject was Mr. Lester S. Ready, Chief Engineer of the California Railroad Commission. He pointed out that a public service corporation once engaged in business is unlike a private concern in that it cannot get out, it must carry on; furthermore, its obligation to expand as conditions require calls for repeated additions to capital; how necessary, then, that the corporation have the public confidence and trust. Mr. Ready thought it essential that the appeal to the public confidence be based upon the highest integrity. It may be said that the text of Mr. Ready's address was "To thine own self be true."

Interconnection of power systems was another theme of discussion at both Atlantic City and Los Angeles. It will be remembered that at the great convention of the National Electric Light Association in San Francisco last year Mr. Herbert Hoover, Secretary of Commerce in President Coolidge's cabinet, speaking before an audience of 6,000 people in the Exposition Auditorium declared his belief that the discovery of long-distance transmission and, from that, the erection of large generating plants and inter-connection of distribution systems had worked a positive revolution in the power industry, a revolution in the direction of adequate and dependable service, with economy of operation and resultant decrease of cost to the consumer. Furthermore, said Mr. Hoover, this central generation and inter-connection did not and would not in any way alter the essential character of regulation by the State Commissions having control of the public utilities in every department of their development and operation. At the Atlantic City convention Mr. W. E. Creed, our company's president, was invited to deliver an address upon this subject of interconnection. He spoke of the immense benefits to all industries in our far-Wetern territory that had resulted from the interconnection of electric transmission lines from the mountains of Oregon to the Mexican border, and he brought these benefits home to the lay mind through an illustration of the practical working of this system that has resulted in the decentralization of populations and industries, stimulating rural activity and effectively working a revolution in the industrial life of the state. We quote:

"Let us take a practical example with the city of San Francisco and the Santa Clara Valley as contrasting communities and by so doing demonstrate the economy of such an arrangement. San Francisco with its demand for lighting, for factory power and for street car transportation lapping over in the late afternoon hours of December represents the maximum winter load. The Santa Clara Valley, a rich orchard section sixty miles long and twenty miles wide, begins where the metropolitan area finds its limit and has at its central point the city of San Jose, which is fifty miles from San Francisco. Tremendous quantities of water are pumped in irrigating the millions of fruit trees of the Santa Clara Valley.

"Suppose there were no interconnected system to serve San Francisco and the Santa Clara Valley and each was supplied by isolated plants! In San Francisco the maximum demand comes in November and December. In the Santa Clara Valley the maximum demand comes in May and June. San Francisco's minimum demand is in the summer; that of Santa Clara Valley in the winter. Without interconnection, the service of each would require a large additional expenditure for steam electric supply. Then San Francisco would have a one-third excess capacity in summer and the Santa Clara Valley would have a one-third excess capacity in winter, which, to put it in another way, would mean that one-third of the power plant facilities of each community would be idle three or four months each year. Interconnection dovetails the demands of both, reduces the investment necessary to supply the service and makes it possible for both to obtain their electric power at a cheaper rate."

At Los Angeles Mr. Pack pointed out that rates for electricity today are as low, if not lower, than they were before the

great war. This happy condition he thought had been largely brought about through the interconnection of transmission systems and, through it, the decentralization of industries.

At this point it may be worth while to call to public attention the expressed opinion of Lord Rothermere, brother of the late Lord Northcliffe, who spent some time in our country recently investigating industrial conditions. Lord Rothermere openly stated his belief that electric power is the secret of the general prosperity of the American people and that a great contributing factor to the present wide distribution and low cost of electric service in the United States is the unification and interconnection of electric generating and distribution systems.

At gatherings like these where men of affairs come together to discuss the problems that most vitally affect their interests and those of the public they serve, it is but natural that political conditions should be touched upon. Public ownership—so miscalled—came up for discussion at Los Angeles. Mr. W. K. Onken, Jr., editor of *The Electrical World*, warned his hearers against what he called socialization as not only choking individual opportunity but imposing an inevitable burden of taxation upon the people. He said:

"It is remarkable how our citizens condone undemocratic and un-American movements and how readily they vote appropriations of millions of dollars for socialistic experiments with the mistaken notion that someone else, not themselves, will have to pay. These persons are in need of elementary lessons in taxation.

"Swollen taxes inevitably express themselves in swollen prices. A city or a state cannot go on spending huge sums in socialistic ventures without raising the cost of living to all citizens. The latter may imagine that they do not have to pay because no tax collector comes to them direct. But they are subject, nevertheless, to a heavy and inescapable taxation in the form of higher rents, a greater outlay for food and raiment and the other necessities of life. Every time a voter favors a large public expenditure for a service which a municipality is not properly qualified to render, he is really voting to boost his own living costs."

Another speaker on the subject of taxation was Dr. Milbank Johnson, president of the California Taxpayers' Association. He reminded his hearers that privately owned public utilities today are paying taxes in amount more than their declared dividends. To hand the public utilities to what is persistently miscalled public ownership would be to throw an unbearable burden of taxation upon all classes of citizens, the farmer, the factory man and the laborer included, through the evil of tax-exempt securities.

Happier notes than these were struck at the gathering in the southland. Mr. A. Emory Wishon, of the San Joaquin Light and Power Corporation, in breezy style told of capital invested to the tune of $7,500,000,000 in the electrical industry throughout the country, of 26,832,000 kilowatts of installed generating capacity, of 675,000 industries owing their vitality to electric power, of 13,000,000 homes wired for electricity, of electric motors performing the work of 175,000,000 men, of the so-called *privately* owned utilities *privately* owned by 1,322,000 citizens. To quote Mr. Wishon:

"Our population is one hundred sixteen million with forty-five million in gainful occupations, or almost four electrical able-bodied slaves for every man earning a living. If we add those electrical slaves which turn night into day, our total electrical slave labor amounts to three hundred million.

"The wage scale of the electrical slave is $5 per year per able-bodied man. These slaves are real workers in the electrical utility business. They do not watch the clock; there is not a lazy man among them; no task is too great and none too mean; no work too good and any good enough. They are never sick, never tired, never incapacitated for duty. They have neither alibis nor excuses; they know not the meaning of disloyalty. They work for the rich and poor alike; the quality of their work is the same to all."

Surely gatherings of this kind are worth while. They are attended by serious-minded men possessed of ability to concentrate upon serious public problems. A serious attitude toward the great problems of the day makes for concentration of thought and purpose, and that concentration, in turn, makes for world progress.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 830,000 CONSUMERS OF

GAS ✦ ELECTRICITY ✦ WATER ✦ STEAM

2,472,404 Total Population Served in Thirty-eight of California's Counties

CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL	
	No.	Population	No.	Population	No.	Population
Electricity	248	1,650,294	48	218,170	296	1,868,464
Gas	70	1,660,800	3	18,202	73	1,679,002
Water (Domestic)	24	90,800	6	19,550	30	110,350
Railway	1	105,000			1	105,000
Steam Heating	2	1,003,000			2	1,003,000

Place	Population	Place	Population	Place	Population	Place	Population
[1]Alameda	35,140	Duncan's Mills	250	Lylton	100	[2]San Bruno	2,175
[2]Albany	6,000	Durham	600	Madison	300	[2-8]San Francisco	708,000
Alamo	100	[5-6]Dutch Flat	400	Magalia	100	[2]San Jose	68,000
Alleghany	300	Dunnigan	150	Manteca	2,000	[6]San Juan	500
Alta	100	Eldridge	500	Manton	65	[2]San Leandro	12,000
Alvarado	1,120	[2-6]El Cerrito	3,000	[2]Mare Island	600	[2]San Lorenzo	1,000
Alviso	640	Elmira	300	[6]Martell	100	[2]San Mateo	11,500
[6]Amador City	750	El Verano	500	Martinez	7,000	[2-6]San Pablo	1,500
Anderson	1,180	[2]Emeryville	5,900	[2]Marysville	8,500	[2]San Quentin	3,500
Angel Island	500	Empire	250	Maxwell	600	[2]San Rafael	7,800
Antioch	2,800	Escalon	700	McArthur	167	[6-7]Santa Clara	6,500
Applegate	100	Esparto	600	[2]Menlo Park	3,500	[6]Santa Cruz	17,500
[6]Aptos	200	[2]Fairfax	1,200	Meridian	250	[2]Santa Rosa	14,000
Arbuckle	900	Fairfield	1,200	[2]Millbrae	350	Saratoga	1,300
Artois	200	Fair Oaks	500	Mills	400	[2]Sausalito	3,800
Asti	100	Fall River Mills	316	[2]Mill Valley	3,500	[2]Sebastopol	2,000
[2]Atherton	800	Farmington	300	Millville	200	Shawmut	100
[5]Auburn	3,000	[6]Felton	300	Milpitas	400	Shasta	46
Bangor	50	Finley	100	Mission San Jose	500	Shellville	200
Banta	50	Folsom City	1,500	Modesto	17,000	Sheridan	50
[2]Barber	500	Forest City	200	Mokelumne Hill	237	Smartsville	300
[2]Belmont	1,000	Forestville	300	[6]Monterey	6,900	[6]Soledad	475
Belvedere	750	[6]French Gulch	170	Monte Rio	500	[6]Soquel	875
Benicia	2,750	[1]Fresno	72,000	[6]Morgan Hill	1,200	Sonoma	1,000
[6]Ben Lomond	500	Gerber	400	[2]Mountain View	3,000	[5-6]Sonora	3,500
[2]Berkeley	80,000	Geyserville	750	Mt. Eden	500	[6]Soulsbyville	200
Bethany	50	[6]Gilroy	3,700	[2]Napa	7,000	[2]South San Francisco	6,500
[6]Biggs	750	Glen Ellen	1,200	Nelson	50	Standard	800
[6]Big Oak Flat	150	Gold Run	50	[3-9]Nevada City	1,800	[2-7]Stanford University	3,652
Bolinas	400	[6]Gonzales	500	Newark	1,100	Stanislaus	100
Boyes Springs	1,000	Graton	250	[5]Newcastle	750	[5-6]Stockton	55,000
Brentwood	500	[3-8]Grass Valley	6,000	Newman	1,250	Suisun	800
[2]Broderick	800	[6]Gridley	2,500	Niles	1,850	Sunol	500
Browns Valley	125	Grimes	500	Nord	60	[2]Sunnyvale	2,700
[2]Burlingame	13,150	[6]Groveland	250	[2-6]Novato	1,000	Sutter City	500
Butte City	200	Guerneville	1,200	[1]North Sacramento	2,500	[8]Sutter Creek	1,000
Byron	400	[6]Hamilton City	390	Oakdale	2,000	Tehama City	200
Calistoga	1,000	Hammonton	500	[2-9]Oakland	295,000	[6-8]Thermalito	250
[2]Campbell	1,500	[2]Hayward	5,000	Oakley	300	Thornton	135
Camp Meeker	300	[6]Healdsburg	3,000	Occidental	600	Tiburon	500
Cana	500	[5]Hercules	600	Orland	2,100	[5]Towle	50
[6]Capitola	450	Hickman	40	[3]Oroville	7,000	Tracy	4,500
[6]Carmel	2,500	[2]Hillsborough	1,000	Pacheco	300	[6]Tres Pinos	400
Cement	1,000	[6]Hollister	4,500	[6]Pacific Grove	5,000	[5-6]Tuolumne	1,500
Centerville	1,775	Honcut	500	[2-6-7]Palo Alto	9,550	Turlock	5,000
Ceres	1,100	Hopland	500	Paradise	600	Upper Lake	750
[2]Chico	12,000	Hughson	625	Patterson	700	[6]Vacaville	1,300
Chico Vecino	2,500	[5]Ione	900	[2]Penn Grove	250	Valley Home	200
Cloverdale	1,000	Irvington	1,200	[5]Penryn	250	[2-6]Vallejo	22,750
[5]Colfax	800	[5-8]Jackson	2,500	Perkins	350	Vina	300
College City	250	[5-6]Jamestown	1,000	[2]Petaluma	7,500	Vineburg	250
Collinsville	300	Kelseyville	600	[2]Piedmont	9,000	Walnut Creek	2,500
[2]Colma	2,900	Kennett	492	[6]Pinole	1,000	Warm Springs	300
[5-6]Columbia	400	[2]Kentfield	1,000	Pittsburg	8,500	Waterford	400
[2]Colusa	2,200	Kenwood	300	Pleasanton	1,800	[6]Watsonville	7,300
Concord	4,200	Keswick	20	Port Costa	990	[6]Weaverville	500
Copperopolis	300	[6]King City	1,600	Potter Valley	600	Wheatland	650
Cordelia	350	Kingston	100	Princeton	300	Williams	800
Corning	1,800	Knights Ferry	200	[2]Red Bluff	3,500	[3]Willows	3,000
[2]Corte Madera	1,000	Knights Landing	525	[3-6]Redding	5,000	Windsor	600
[2]Cotati	600	La Fayette	300	[2]Redwood City	8,000	Winters	900
Cottonwood	704	[5]La Grange	200	[2-6]Richmond	28,700	[2]Woodland	6,950
Coyote	250	Lakeport	1,250	Richvale	500	Woodside	300
Crockett	2,500	[2]Larkspur	1,000	Rio Nido	250	Wyandotte	250
Crows Landing	300	Lathrop	300	Rio Vista	1,100	Yolo	400
[2]Daly City	6,500	[2]Lawndale	60	Ripon	1,000	[2]Yuba City	4,000
Danville	500	Lewiston	100	Riverbank	1,200	Zamora	100
Davenport	500	[5-8]Lincoln	2,000	[5]Rocklin	700	Total Cities and Towns	1,983,104
[2]Davis	1,750	Live Oak	1,000	[6]Rodeo	900	Add Suburban Population	489,300
Dayton	60	[6]Livermore	3,600	[6-8]Roseville	7,000		
Decoto	700	[1]Lodi	5,000	[2]Ross	900	Total Population Served	2,472,404
[6]Del Monte	300	[2]Lomita Park	1,325	[4]Sacramento	105,000		
Denair	400	[5]Loomis	500	Salida	300		
[5]Dixon	1,200	Los Altos	1,800	[6]Salinas	6,500		
Dobbins	100	[2]Los Gatos	4,750	San Andreas	600		
Drytown	200	Los Molinos	460	[2]San Anselmo	4,500		

Unmarked—Electricity only.

1—Gas only.

2—Gas and Electricity.

3—Gas, Electricity and Water.

4—Gas Elect. and St. Railways.

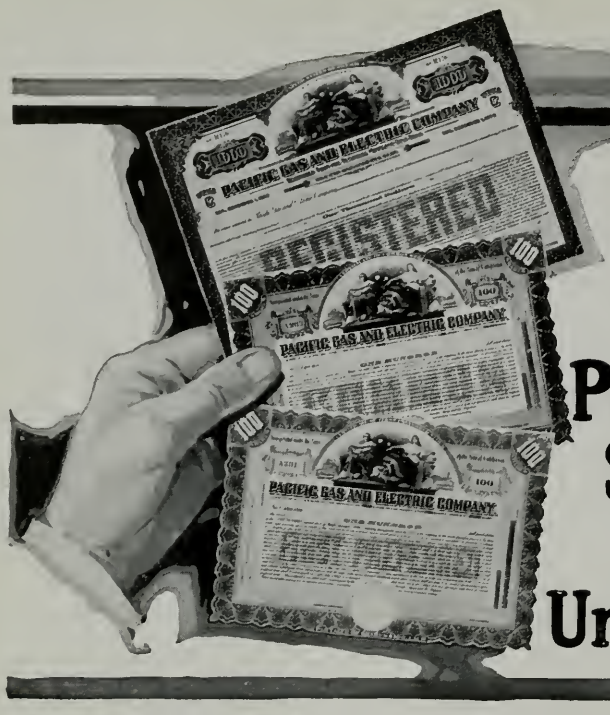
5—Electricity and Water.

6—Electricity supplied through other companies.

7—Gas supplied through other companies.

8—Water supplied through other companies.

9—Steam Heating.



Three of the Premier Public Utility Securities of the United States

Pacific Gas and Electric Company

First and Refunding Mortgage Bonds
First Preferred Stock (6%)
Common Stock (8%)

Every One of the
Eighty Thousand Investors
owning Bonds
or Stocks of the
Pacific Gas & Electric Company
receives
A Regular Income
from his investment

are held in high regard by the investing public because

They are securities of one of the largest, strongest and most progressive of the nation's public service companies;

The property securing these issues is worth millions of dollars more than the entire outstanding capitalization;

The Company's business is essential in character, and is increasing steadily year by year;

These securities are always readily marketable. They are listed on Stock Exchanges in San Francisco and other financial centers.

PACIFIC GAS AND ELECTRIC COMPANY
Stock Sales Department
245 MARKET STREET SAN FRANCISCO, CAL.

PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO



AFTERBAY DAM, DRUM POWER DEVELOPMENT

Vol 16 — OCTOBER 1926 — No 10

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER	A. B. C. DOHRMANN	FRANK A. LEACH, JR.
FRANK B. ANDERSON	JOHN S. DRUM	NORMAN B. LIVERMORE
CHAS. L. BARRETT	F. T. ELSEY	JOHN A. McCANDLESS
W. E. CREED	D. H. FOOTE	JOHN D. McKEE
W. H. CROCKER	A. F. HOCKENBEAMER	C. O. G. MILLER

OFFICERS

W. E. CREED	*President*
FRANK A. LEACH, JR.	*First Vice-President and General Manager*
A. F. HOCKENBEAMER	*Second Vice-President and Treasurer*
D. H. FOOTE	*Third Vice-President and Secretary*
CHAS. L. BARRETT	*Assistant Secretary*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, JR., Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney	LAW DEPARTMENT
C. P. CUTTEN, Attorney	RATE DEPARTMENT
R. J. CANTRELL, Manager	PROPERTY AND TAX DEPARTMENT
E. W. HODGES, General Auditor	ACCOUNTING DEPARTMENT
H. T. TERRY	CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager	CREDIT AND STOCK SALES DEPARTMENTS
JOHN H. HUNT, Purchasing Agent	PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent	SUPPLY DEPARTMENT
E. G. McCANN, Manager	PERSONNEL DEPARTMENT
	ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT
O. W. PETERSON	Engineer of General Construction
E. H. STEELE	Engineer of Line Construction
F. R. GEORGE	Engineer of Operation
GEO. H. BRAGG	Engineer of Maintenance
	DEPARTMENT OF ENGINEERING
J. P. JOLLYMAN	Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER	Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE	Chief of Division of Civil Engineering
F. M. HARRIS	Chief of Bureau of Specifications and Estimates
O. A. KNOPP	Chief of Bureau of Tests and Inspection
	DEPARTMENT OF EXECUTIVE ENGINEER
F. C. PIATT	Valuation Engineer of Electric Properties
J. T. RYAN	Valuation Engineer of Gas, Water and Railway Properties
B. B. BECKETT	Rate Engineer
S. B. SHAW	Automotive Engineer
W. G. JACK	Manager Land Department
	GAS CONSTRUCTION AND OPERATION DEPARTMENT
FRANK WILLS	Engineer of Production
R. S. FULLER	Engineer of Distribution
HARRY J. SMITH	Engineer of Construction
	PUBLIC RELATIONS AND SALES DEPARTMENT
R. W. ROBINSON	Assistant to Vice-President in Charge of Public Relations and Sales
DON C. RAY	Manager Bureau of Public Relations
N. R. SUTHERLAND	Manager Commercial Department
H. M. CRAWFORD	General Sales Manager
R. T. STEPHENS	Manager Electric Sales
FORREST U. NAYLOR	Manager Gas Sales
J. CHARLES JORDAN	Manager Publicity Department

W. B. BOSLEY
General Counsel

JOHN P. COGHLAN
Assistant to the President

F. S. MYRTLE
Editor-in-Chief Pacific Service Magazine

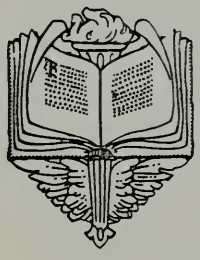
DIVISIONS AND MANAGERS

DIVISION MANAGERS		DISTRICT MANAGERS		HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION			Marysville
		C. R. GILL	Colusa District	Colusa
I. B. ADAMS	DE SABLA DIVISION			Chico
H. M. COOPER	DRUM DIVISION			Auburn
		L. H. HARTSOCK	Nevada District	Nevada City
		J. V. KYLE	Placer County District	Auburn
I. H. NEWBERT	EAST BAY DIVISION			Oakland
		J. H. PAPE	Berkeley District	Berkeley
H. C. ROSS	FRESNO DIVISION			Fresno
H. G. RIDGWAY	NORTH BAY DIVISION			San Rafael
		L. J. PETERSON	Petaluma District	Petaluma
		C. D. CLARK	Napa District	Napa
		C. D. CLARK	Vallejo District	Vallejo
		M. G. HALL	Santa Rosa District	Santa Rosa
E. W. FLORENCE	SACRAMENTO DIVISION			Sacramento
		C. E. SEDGWICK	Solano District	Dixon
HENRY BOSTWICK	SAN FRANCISCO DIVISION	J. W. COONS	Yolo District	Woodland
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION			San Francisco
				Modesto
		W. E. ESKEW	Electra District	Jackson
		J. H. FAGG	Stockton District	Stockton
		CHAS. H. NOACK	Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION			San Jose
		W. T. KELLOGG	Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION			Redding
H. B. HERYFORD	WEST SIDE DIVISION			Red Bluff
		STEPHEN GOIN	Willows District	Willows
		CHAS. HUGHES	Red Bluff District	Red Bluff

Pacific Service Magazine

Volume XVI Number 10

Contents for October, 1926



SAN JOSE AS AN INDUSTRIAL CENTER - - - - *Frontispiece*

"PACIFIC SERVICE" AND THE FACTORY—
THE PRESENT TENDENCY TOWARD DECENTRALIZATION OF INDUSTRY AS A RESULT OF INTERCONNECTION OF HIGH-TENSION POWER SYSTEMS - - - - - - - - 307

SAN FRANCISCO PENINSULA ONE LONG LINE OF INDUSTRY - 311

INTERCONNECTION AND INDUSTRY IN EAST BAY TERRITORY 318

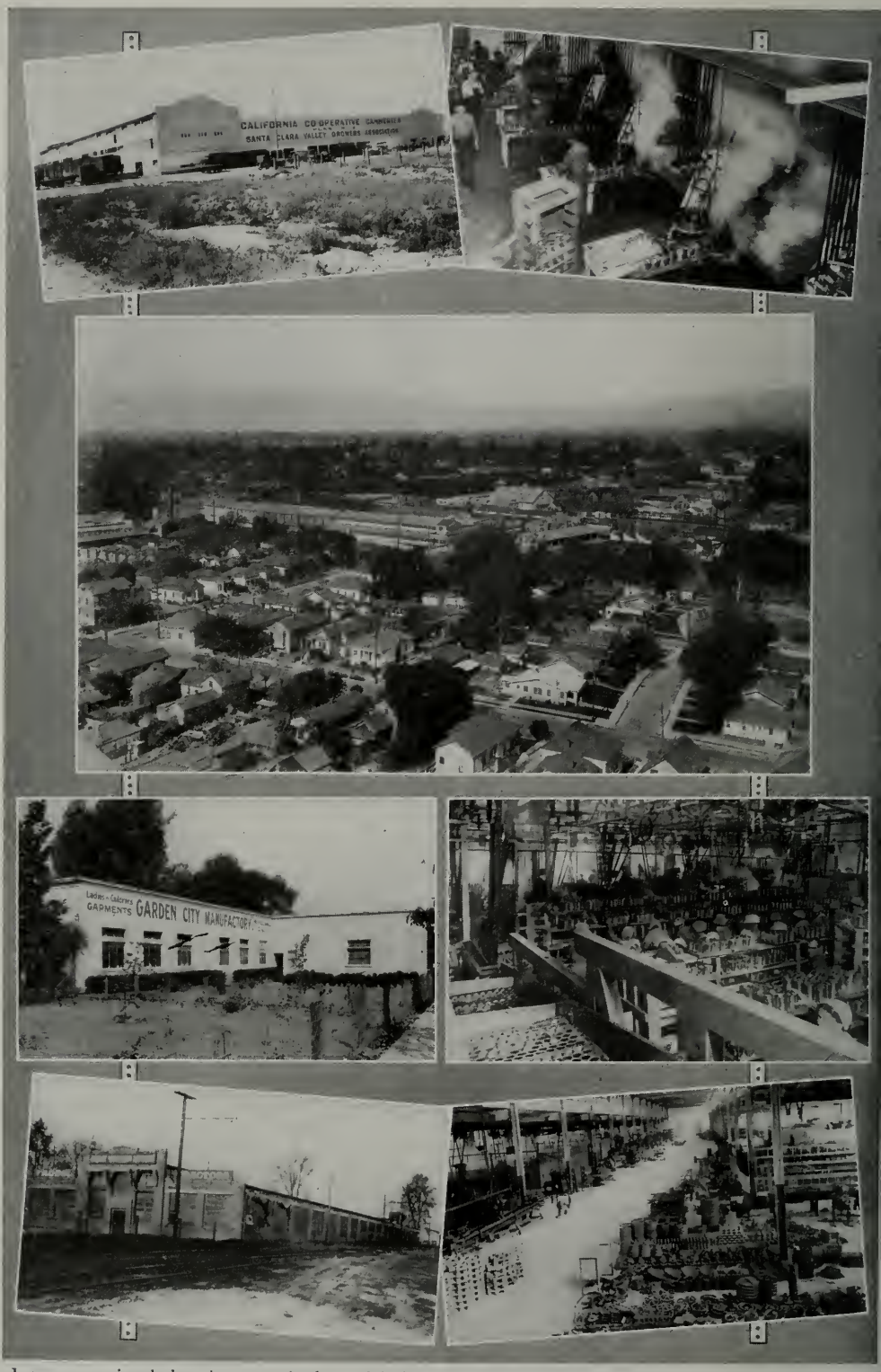
INDUSTRIES SPREAD THROUGH THE NORTH BAY COUNTIES 325

MARCH OF INDUSTRY THROUGH CALIFORNIA'S GOLDEN VALLEYS - - - - - - - - - - - - - - 330

ELECTRICITY REPLACES STEAM AT SANTA CLARA WATER WORKS - - - - - - - - - - - - 334

THE FINANCIAL SIDE OF "PACIFIC SERVICE" - - - - - 336

EDITORIAL - - - - - - - - - - - - - - 338



Interconnection helps the spread of rural industry in the Santa Clara Valley. The upper views, left and right, are of the California Co-operative Canneries, at San Jose; in the center is a view of the Garden City as an industrial community; below, in order, are views of the following plants: Garden City Manufactory, Santa Clara Valley Canning Company, Great Western Motors.

PACIFIC SERVICE MAGAZINE

Volume XVI OCTOBER, 1926 Number 10

"Pacific Service" and the Factory

The Present Tendency Toward Decentralization of Industry as a Result of the Unification and Interconnection of Hydro-Electric Power Systems.

In the past, manufacturing plants, save in the few cases in which closeness to raw material was the controlling factor, have generally located in cities in order to secure convenient, reliable central station power. If they located outside of cities, they had to have their own power plants, which was so often uneconomical, and there was the added disadvantage, amounting often to a calamity, of having to shut down a whole industry in case of trouble. With the creation of the interconnected hydro-power lines running primarily from the hydro-generating plants in the mountains to the cities loads could be tapped en route for industries located outside the cities. This offered industry the advantage of cheap power anywhere and the interconnection of transmission lines insured against interruption of service.

W. E. CREED—From an address delivered before the 49th Convention of the National Electric Light Association, Atlantic City, May 17-21, 1926.

With the founding of the Federal Reserve Banking system, in 1913, the financial structure of American business was to a large extent revolutionized through the simple expedient of interconnection. Boiled down to its irreducible minimum, the function of the Federal Reserve Bank as a unit, is to furnish and maintain the machinery for balancing a credit surplus in one community against a credit stringency in another. Through the practical working of this interconnection, Texas oil may be called upon to harvest Iowa's corn crop and Pennsylvania steel may log and ship Oregon's lumber cut.

Without such an interconnection, local banks prospered in proportion to the prosperity of their immediate communities; the Iowa banks failed when Iowa's corn crop failed, regardless of an unprecedented prosperity in Texas and Pennsylvania. Interconnection through the medium of unification and interconnection furnished by the Federal Reserve system simply capitalized the probability that corn, oil, steel and lumber would not all fail or be hard pressed for credit at the same time, and that the prosperity of the one could support the stringency of the other.

Economists call this the Law of Averages; power companies call it Diversity. Both names are equally descriptive and any organization, whether social, political or industrial, can in some way measure the degree of its stability by the application of this principle. The analogy between the Federal Reserve system and a great interconnected power system is not perfect, but it serves to suggest other more obvious and more apt illustrations of the inherent soundness of any producing and marketing unit that establishes both of these functions upon a firm basis of diversity, whether geographical or industrial or both. So much for a definition of terms.

In general, the location of an industrial or factory site is determined by the relative availability of four primary factors, raw material, labor, power and market. Economic history since the eighteenth century has been the story of successive industrial and social adjustments as invention and private initiative have upset the complacent status quo by introducing new and revolutionary developments in one or more of these four prime factors.

Eighteenth Century England saw Industry suddenly uprooted from its time honored place at the family hearth and moved to ungainly, inefficient factories located at waterfalls. Labor and raw material followed as best they might. Power was the thing. The factory system had hardly settled down to the new basis when it became necessary to readjust itself to the new con-

ditions brought about by the invention of the steam engine and the subsequent rapid development of steam transportation. Steam was cheaper than waterpower and transportation brought the market to the factory door. The old factory sites were consequently abandoned and industry crowded to points where raw material and rail met. Power and market had become flexible and raw material became the determining factor.

California's industrial history opened with this era and for twenty-five years its industrial development was characterized, in general, by the same limitations that have retarded its English prototype since the close of the so-called Industrial Revolution. The point of divergence that was to mark California's forward step in pioneering the new industrial era came during the closing years of the last century.

The mines of the Mother Lode had already reached the limit of their productiveness under the old system. Steam was out of the question. Water power projects were developed as a hopeful substitute, but, when brought to completion, the makeshift was cumbersome, inefficient and too costly to operate. Gold dredging had not yet proved feasible. Industry was largely local and existed generally on a hand-to-mouth basis. The productiveness of the great interior wheat fields had waned alarmingly through the lack of irrigation and crop rotation. The coastal cities, always dependent to a great extent upon the back country, were beginning to feel the reaction.

But by this time, coming events had begun to cast their shadow before them. The "brainstorm" of de Sabla and Martin had already proved to the Grass Valley miners that the power delivered through three thin strands of wire could mine the gold and unwater the shafts and leave a good margin of profit where steam and water power could only operate at a loss. Hard on the heels of its first successes the infant hydro system was extended to supply Marysville and the adjacent agricultural territory, as its first step toward the rich load centers around the bay.

In the meantime, hydro-electric power from Folsom, backed up by a steam standby plant at the other end of the line in Sacramento, had already established another principle: that industrial plants, located in cities on transportation, could likewise operate more economically on hydro-electric power than on their self-contained steam plants. In 1897, the principal industrial plants on the new distribution system in Sacramento were the Buffalo brewery, the Southern Pacific shops and the Phoenix mills. Today the Southern Pacific shops rank with the ten largest power consumers in "Pacific Service."

During the summer of 1898, when the American River at Folsom fell below the level of the penstocks, the Yuba was maintaining a sustained flow considerably in excess of the power requirements of the new Colgate powerhouse. Interconnection between the two embryonic systems was the obvious solution, and with the completion of the transmission line from Colgate to Sacramento on September 5, 1899, the model of "Pacific Service" as an interconnected power system was formed with all of the essential characteristics of the greater pattern cut in miniature. Two power houses on separate watersheds were operated in parallel with a steam plant to supply two comparatively distant cities with light and to serve industry and agriculture with power.

The separate watersheds gave the stability of geographical diversity in annual production; the steam plant gave continuity of service in daily production. In supplying two relatively distant cities that depended upon widely divergent industries for their income, the new system secured geographical diversity in its market. By offsetting its winter lighting and heating peak with summer pumping, the system assured itself an economical diversity in annual load. By supplying industry it secured a steady daily peak demand to offset its daily lighting peak. Since then "Pacific Service" has grown in proportion to the soundness of these first principles and it is this intrinsic stability that has formed the basis for the main premise that the general availability of a reliable source of power in rural territory has been a prime factor in the contemporary migration of industry from high-priced, congested city locations to cheaper and more spacious rural sites.

The swing of the pendulum toward the centralization of industry began with the distribution of steam-generated power in San Francisco in 1879, in Oakland in 1881 and in Sacramento in '84. By 1886 every prin-

cipal city in the State had its own local electric company and had begun to draw industry to sites within the narrow radius of its distribution system. Developments in high voltage insulation and transformation in 1890 lengthened the radius and relieved the tendency toward saturation to some extent, but the inevitable line losses drew a very definite boundary beyond which the steam central station could not compete with the factory's self-contained steam plant.

The tendency toward the centralization of industrial development reached its zenith with the advent of the new century and began to decline in 1901 with the completion of the Bay Counties Power Company's transmission lines from Colgate powerhouse to Oakland. Impetus was given to the decline by the completion of the Standard Electric Company's transmission line to San Francisco via Stockton and San Jose in 1903.

The situation at that time was surely one to tempt organizing genius. Six main avenues of cheap hydro-electric power crossed the central valleys and converged at San Francisco Bay, tapping, en route, the centers of eighteen struggling local distribution systems and traversing the richest potential rural industrial belts in Northern California. In 1903 five of the major distributing and producing companies were consolidated to form one unified system in the northern part of the territory comprising Sacramento, Chico, Colusa, the Grass Valley system, Marysville, Napa, Petaluma, Santa Rosa, San Rafael and Oakland. The next year the Standard Electric Company was brought into the system with its subsidiaries supplying San Jose, Redwood City, San Mateo and, to a limited degree, San Francisco. By 1904, tap lines had been built westerly from Crockett to Richmond and easterly from Crockett through Martinez and Antioch to a junction with the main standard transmission line at Herdlyn, midway between Stockton and San Jose.

The earliest and most obvious type of rural industrial consumers to come on to the new power lines were the Grass Valley and Amador County mines. To many of them the advent of hydro power meant the difference between prosperity and extinction. "Pacific Service" and its pioneers can assume most, if not all, of the credit for saving many of the present thriving mining towns from the fate of Columbia and Poker Flat.

The gradual lowering of power rates has maintained a sufficient lead over the concurrent decline in ore values to result in a total system increase from approximately 2,500 horsepower in 1900, to 26,500 horsepower in 1914, to 41,000 horsepower in 1926 of mining load.

The mining industry is typical of that great class of rural enterprise wherein the location of the raw material determines the location of the plant. The removal of choice naturally eliminates these industries as examples of the present tendency toward decentralization. It is rather the other phase of interconnection that has made the majority of these developments possible, the availability of cheap, flexible, reliable power.

Of the one hundred largest power consumers on "Pacific Service," approximately one-half are strictly industrial, and of that number one-half are of this class. They are the cement plants, the mines, the dredgers, the lumber mills and kindred industries that locate at their sources, are big because they depend upon volume of production in a bulky commodity and live because cheap power is the essence of that type of industry.

The tendency toward decentralization is chiefly apparent among industries that are engaged in the manufacture or fabrication of raw materials imported in a semi-finished form for sale in a general market. They are the steel plants, the shipyards, the oil refineries, the paper mills, tanneries, meat packers, ice-plants—all of that various class that forms the bulk of the system's industrial load.

The decade following the incorporation of the Pacific Gas and Electric Company in 1905 was principally one of organization and coordination within the company. Insofar as large industrial load was concerned, the company's first problem was to sufficiently establish its reputation for continuity of service to overcome the scepticism of the champions of steam and convert their plants to electric drive.

Probably the greatest constructive step toward putting interconnection on a flexible working basis was the institution, in 1906, of the present plan of load dispatching and its immediate adoption by every other major company in the State. Through this method

of load dispatching, every portion of the system is perfectly coordinated to meet and dispose of the many operative emergencies to which a great power system is naturally heir. It husbands the stored water above the power houses; it economizes on the consumption of oil by regulating the use of the steam plants; but, mainly from the standpoint of the manufacturer, it prevents local mishaps from causing a complete interruption to the entire interconnected network.

The cumulative force of organization and unceasing sales effort soon became apparent along very definite lines. Electric power in manufacturing had ceased to be an experiment and had become an economic necessity. The pioneers in rural industrial electrification had begun to speed up the process of converting from steam to electric drive and new industrial territories were rapidly opening up along the routes of the principal transmission lines. It was during the latter part of this period that the South San Francisco industrial region and the industrial territory along the Alameda and Contra Costa water fronts first began to promise the growth that has come.

During the last ten years, from 1916 to date, the rural industrial load in the Bay region has increased three times its 1916 figure, or at twice the rate of increase in the cities. While the process of decentralization has been apparent over the balance of the system, its force in determining the establishment of definite industrial regions has not been as marked, nor is it as typical of the true tendency illustrated in the bay region. However, if the State continues to grow in the same ratio that it has in the past, and there is every reason to believe that it will, we may be very certain that future industrial development will follow the evident tendency toward ruralization that has been made possible by interconnection and its resultant sound basis of growth in the interior.

San Francisco Peninsula One Long Line of Industry

Traveling down the San Francisco peninsula on the historical El Camino Real through the smaller towns in San Mateo and Santa Clara counties, one is amazed at the number of thriving industries that have sprung into existence in recent years. The thoughtful person wonders just what particular advantages have brought about the location of these industries in the smaller communities somewhat away from the larger centers of population. While many advantages, such as splendid climate and healthy and wholesome places for workers to live, together with excellent transportation facilities and rates and unlimited room for expansion, have all combined to make the selection of rural sites desirable, yet behind all of these advantages lies a greater and over-shadowing advantage of prime importance to all industry, and that is the availability of an unlimited supply of cheap and reliable electric power.

The first striking instance of rural industrial development that reaches one's eye journeying down the peninsula, is the large industrial group around South San Francisco. Here many thousands of horse-power of electric motors are doing the work of industry, some ceaselessly night and day. The growth of this industrial load from approximately 3,000 horse-power in 1913 to nearly 25,000 horse-power in 1926 is indeed a wonderful testimony to the economic success of the power supply furnished. The outstanding point that is so noticeable in South San Francisco, as well as in all the adjacent rural area, is that there is comparatively little steam power used; the industries find that their cost of power from "Pacific Service" is much less than steam-generated power, as well as being more reliable. Continuity of service is provided by six circuits of high voltage transmission lines which bring power around the bay from hydro-electric stations located in the High Sierras. Also, the large steam stand-by stations in San Francisco and Oakland provide through numerous trans-bay cables and interconnecting busses an unfailing assurance that power service to industry will continue even though the angry elements should tear down one or more of the transmission lines that are so securely builded with steel towers resting on stone foundations.

Some idea of the present extent of rural industrial development in the neighborhood of South San Francisco can be obtained from the size of the payroll which runs well over a half-million dollars a month in South San Francisco alone.

Electric power is not the only contribution that "Pacific Service" has made to the rural industrial growth, for the development of high pressure transmission down the peninsula has given a reliable, economical, and unfailing gas supply to the many industries that have built up in its pathway. Commencing at the Potrero Gas Plant in San Francisco and running southward along the peninsula by way of Redwood City, this high pressure line now is continuous to San Jose, where it connects with the large modern gas plant at the



Pacific Coast Steel Company's manufacturing works at South San Francisco.

Garden City. A storage reservoir and pressure pumping equipment at Redwood City guarantee reliability of service both ways from that point.

The Joshua Hendy Iron Works at the town of Sunnyvale, located many miles from either gas plant, secures service from this line. Consumption at this plant is constantly growing, and is an economic application to the processes involved as evidenced by the testimony of the management. Among the many industries in the South San Francisco area that are using gas from this interconnected high pressure line are such well-known firms as Virden Packing Company, Richfield Oil Company, Western Pipe and Steel Company, Wildberg Brothers (rare metal refiners), Western Meat Company, American Marble and Mosaic, Growers' Rice Company, Pacific Sheet Steel Corporation, E. H. Edwards Wire Rope Company, W. P. Fuller Company, Metal and Thermit Corporation and Enterprise Foundry.



Fontana Food Products Company's plant, South San Francisco.

As we journey farther southward toward the Valley of Santa Clara, we find not only industries that have located in the rural areas on account of climate, transportation, and room for expansion but, also, many industries that have located their plants at the source of one of their major raw materials; as, for instance, the Plant Rubber and Asbestos Company and the National Magnesia Manufacturing Company, and the West Coast Porcelain Company, all near Redwood City. These plants use large quantities of magnesium, which is obtained in the form of magnesium chloride as one of the by-products in the extraction of salt from sea water. The availability of an unfailing supply of cheap electric power in the communities where the raw material abounds makes possible the advantageous location of these factories.

Journeying farther southward, we enter the beautiful Santa Clara Valley, which in springtime presents to one's view a sea of blossoms, approximately twenty miles wide and forty miles long. These blossoms, while they delight the eye with their beauty and the sense of smell with their fragrance, give an even greater promise of delicious fruit, which in the late summer and fall is harvested, packed and sent to the four corners of the world. The ability to pack and preserve this fruit the same day it is picked, right in the heart of the orchards where it grows, has made possible this great horticultural development that provides nearly 100,000 people with not only an excellent vocation but, also, a happy, healthy and comfortable rural life, where approximately 250 days of sunshine a year make for the finest living conditions that are known in the State. To this great horti-



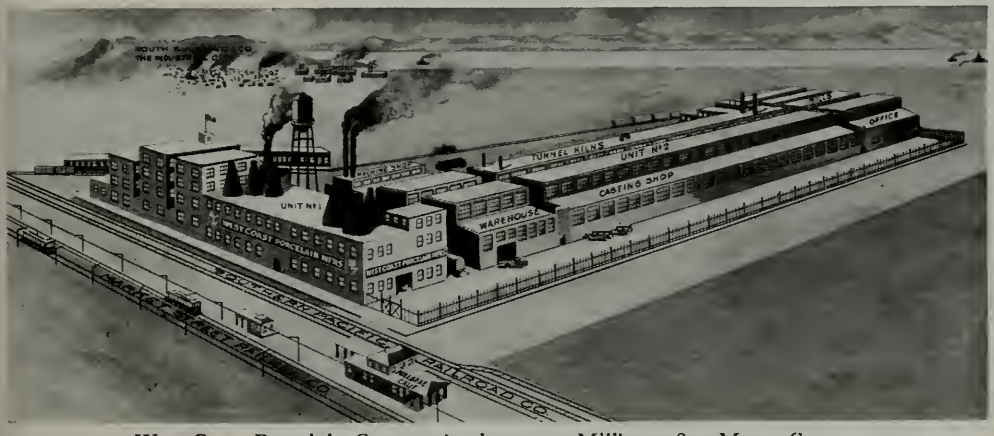
Plant of the Pacific Sheet Steel Corporation, South San Francisco.

cultural development "Pacific Service" has lent a real hand, for it is doubtful if the enormous crops of fresh fruit which must be cared for immediately could be satisfactorily or economically handled were it not for the electric power supply, both cheap and unfailing, which is provided by the great interconnected system of the Pacific Gas and Electric Company.

That "Pacific Service" is contributing in no small measure to the development of Santa Clara Valley may be seen from the following figures taken as of September 30, 1926. At that date, in Santa Clara Valley alone, there was 45,326 horse-power of agricultural motor installation and there were 1177 rural homes made more comfortable by electric ranges, water heaters and, in many instances, air heaters, that were making life on the farm more comfortable and attractive. While in many communities and areas in the United States the tendency in past years has been away from the rural home or farm, the condition in Santa Clara Valley has been decidedly the reverse. The 743 miles of overhead distribution lines which carry city conveniences to the country homes in Santa Clara Valley testify how thoroughly "Pacific Service" has united with the hand of nature to make country life here attractive and more than double the rural population in the past fifteen years.

As one journeys on through this beautiful valley, one may seek the rolling foothills to obtain a better view of this prosperous section of country and find concealed in many of the canyons surrounding the valley industries served by electric power that are sending their products to all parts of the world. Some of these plants have found their raw materials in the rich natural deposits of the Coast Range mountains and have been able to locate their plants right at nature's store-house, and receive an ample and reliable power supply even in the remotest locations. Included in the list are such plants as the Bernal Marl Fertilizer Company near Edenvale and the Santa Cruz-Portland Cement Company in the Santa Cruz mountains at Davenport. This plant, it might be mentioned, has approximately 15,000 horse-power connected and runs twenty-four hours a day. "Pacific Service" has been a great factor in the growth and success of this industry. The Maltby magnesite mines, located approximately twenty-five miles east of the Lick Observatory in a most mountainous and inaccessible region, are now served by power from the P. G. & E. lines at a great saving in cost of fuel which, before connection to power lines, had to be transported by truck forty-two miles by road from Livermore through winding mountain passes.

Mention has been made of a fact of the part "Pacific Service" has played in developing the great horticultural area in Santa Clara Valley, and making possible the economical operation of the canning, packing and preserving industry. Mention might be made of a few of the plants whose locations are in the heart of the orchard district and whose growth has been greatly assisted through an unfailing supply of cheap power. Flickinger's orchard cannery



West Coast Porcelain Company's plant near Millbrae, San Mateo County.



Rosenberg Brothers' packing house at Santa Clara.

on Berryessa road, about three and one-half miles east of San Jose, was one of the pioneer plants which tried the plan of locating right in the center of the orchard which produced their fruit. This plant was built over twenty years ago, and the rural electric line extension to serve it was one of the first steps in rural electrification in Santa Clara valley. Here, with orchards stretching out for miles in all directions from this cannery, fruit is picked dead ripe from the trees, placed on a small one-horse truck and carted directly to the cannery floor, where within a few hours its delicious flavor has been preserved for the enjoyment of people in all parts of the world. "Pacific Service" has played its part in making possible this achievement of modern civilization. With the success of canneries located in the heart of the orchard district came a wonderful growth in the planting of orchards, for here opened an outlet for the fruit. That the availability of power has enabled the rural horticultural development here, is unquestioned. Among the many large plants located in the heart of the orchard district may be mentioned Libby, McNeil and Libby's enormous plant at Sunnyvale, the J. C. Ainsley Company's and George E. Hyde Company's plants at Campbell, the Hunt Brothers plant at Los Gatos, and the many plants of the California Packing Corporation and the Richmond Chase Company, which are scattered throughout the valley.

Returning to the City of San Jose itself, we find at every hand, beautiful and comfortable homes of great masses of common people. The sure and steady growth of this community has not alone been built by the fruit industry, for many manufacturing industries have found that here is not only a most pleasant and wholesome place for workers to live but, also, transportation and an abundance of power made this community almost ideal for the location of their factory. Take, for instance, the Bean Spray Pump Company, which has "grown up" in Santa Clara valley. This firm was incorporated in 1903 when it was doing a business of about $30,000, annually and had about $15,000 invested capital. Its growth throughout intervening years has been continuous until, at the present time, its business exceeds $1,500,000 a year, and shipments of the machinery which it manufactures go out to every part of the world. In 1910, the Bean Spray Pump Company established a factory at Lansing, Michigan, to supply the Eastern part of the United States, but this is entirely owned by Santa Clara valley stockholders. Since the San Jose and Lansing factories manufacture exactly the same goods it



Home of the Pacific Manufacturing Company at Santa Clara.

is possible to secure some accurate comparisons between the desirability of the Eastern and Western Factory locations. Mr. John D. Crummey, the president of the Bean Spray Company, in an interview, brought out some very interesting facts in favor of the Santa Clara Valley location:

First, the San Jose factory has the advantage of much less expensive buildings with consequently lower depreciations, interest and insurance charges, and the milder climate here gives a much lower cost for heating.

Second, while the merchandise investment is somewhat larger at the Western factory because of distance from markets, yet raw materials such as pig-iron, structural and cold-rolled steel, etc., through water service by way of the Panama canal can be delivered at as low a price f.o.b. San Jose as their cost f.o.b. Lansing, Michigan. Mr. Crummey states that the terminal freight rates which San Jose enjoys places local industries in a very advantageous position from a transportation standpoint, both on



incoming and outgoing shipments.

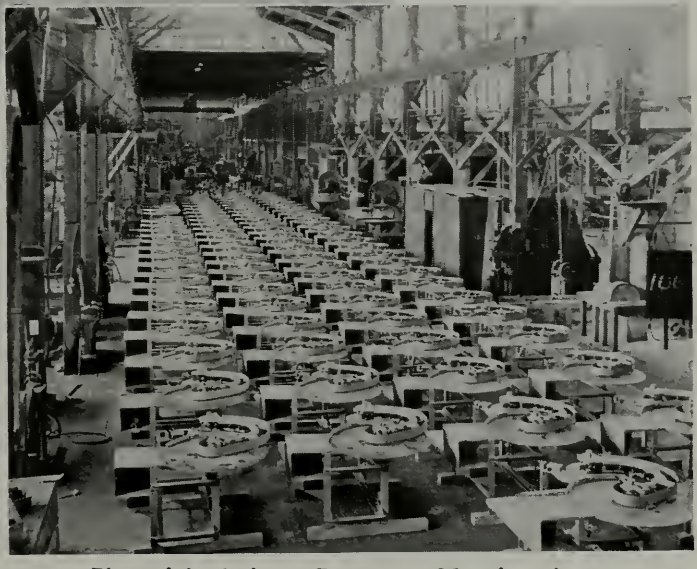
Third, the Bean Spray Pump Company uses electric power in both of its factories, and Mr. Crummey stated that the electric power service for 559 horse-power at the San Jose factory not only is nearly perfect from a continuity standpoint but, also, costs far less per kilowatt-hour than the amount paid for electric power at the Eastern factory.

Fourth, labor costs at the two factories were approximately the same, differing slightly as regards skilled labor and unskilled labor, the San Jose plant paying a slightly higher rate for skilled labor and a much lower rate for unskilled labor. Mr. Crummey points out that the rush season of this San Jose plant dovetails in with the demands of other industries, especially the fruit industry, in providing a splendid supply of unskilled labor at the seasons when required; the Bean Spray Pump Company commencing its busiest season directly after the fruit season closes and continuing through the winter until spring.

Fifth, Mr. Crummey states that the mild climate which allows healthful outdoor sports and recreations throughout practically the whole year promotes a better state of health and personal efficiency than can be found in the East.

Another large industry that has grown up and prospered in the Santa Clara valley is the Anderson-Barngrover Manufacturing Company in San Jose. Mr. W. C. Anderson, its president and one of the founders, gives some very interesting data in regard to growth and present activities.

About thirty years ago, Mr. Anderson and his partner, Mr. Barn-



Plant of the Anderson-Barngrover Manufacturing Company at San Jose.

grover, commenced making machinery in a small way to serve the fruit and packing industries, originally equipping the canneries and fruit-drying establishments in Santa Clara valley and, later, equipping more distant plants. In 1902 the firm of Anderson and Barngrover was incorporated, and the enterprise has gradually grown and prospered until now the cash value of the products manufactured exceeds a million dollars.

Over 200 employees at the San Jose plant of this Company operate the machinery driven by 877 horsepower of electric motors. "Pacific Service" supplies the power, and Mr. Anderson pays a very high compliment to its courteous and continuous service. Without adequate cheap and reliable power supply all other advantages, such as climate, transportation and wholesome environment for employees, might prove insufficient to establish a decision upon plant location.



To those who are not familiar with the extent of the market for cannery and packing machinery it might be well to point out that the line of goods manufactured covers the general canning and packing machinery used in the canning, packing and processing of fruits, meat, milk and vegetables. Branches in Baltimore, Md., Indianapolis, Ind., Chicago, Ill., Los Angeles, Calif., and agencies in Australia and Canada, distribute this machinery to the large canning and packing industries of the North American continent and Australia. A few plants in Europe and Continental Asia have been equipped by the Anderson-Barngrover Company. Some famous milk-canning plants in Wisconsin, Michigan and Ohio, such as Borden, Libby, McNeil & Libby and Van Camp, have been equipped by this local firm. A large number of the pineapple plants in the Hawaiian Islands are also using the machinery bearing the Anderson-Barngrover trademark.

Mr. Anderson's experience with the type of service rendered by "Pacific Service" in providing continuous and cheap power for his factory is reflected in the fact that his home at Los Gatos built several years ago, is one of the first completely equipped electrical homes in the Santa Clara valley. Electric heating, cooking and water heating, together with the various auxiliary uses, supply every need for fuel and the home is so completely electrified that no chimneys were built into the house whatever. Mr. Anderson proudly states that in all these years he has never missed a meal for lack of electricity, nor ever wished for any other type of fuel.

"I find our present location in Santa Clara valley to be almost an ideal site for a factory



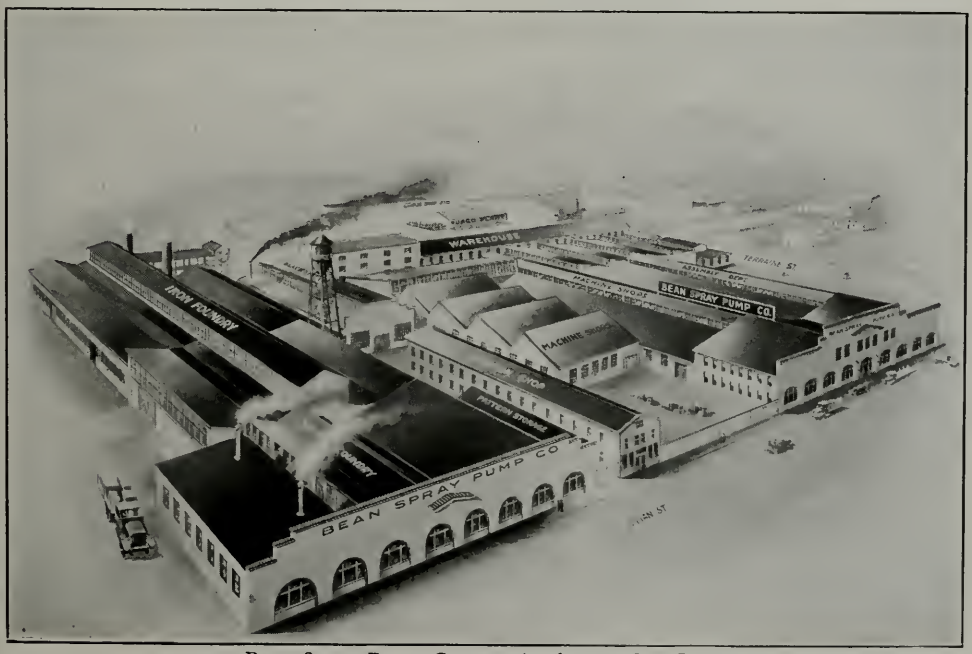
Plant of the Geo. E. Hyde Company at Campbell, Santa Clara County.

such as ours. Labor conditions are excellent, the climate is ideal for the best efficiency of the workers; transportation rates and facilities are splendid, land for expansion is comparatively cheap and we have no problem of obtaining adequate and reliable power supply," states Mr. Anderson. "We let the Pacific Gas and Electric Company worry about that for us, and they are doing a good job at a much cheaper rate than we could supply our own power. I am better satisfied with conditions here than I believe I would be in a more populous area."



The new Guadeloupe Quicksilver Mine, near San Jose.

Many other industries have located in and near San Jose, but space does not permit a detailed account of their activities. Some idea of the extent of the growth of industries in Santa Clara valley show by records of September 30, 1926 that over 26,000 horse-power of electric motors is being used for manufacturing purposes in Santa Clara valley alone. The total horsepower used in manufacturing in Santa Clara and San Mateo counties combined amounts to 54,473 horse-power. These figures cover manufacturing motors only, the total horsepower of manufacturing agricultural and miscellaneous motors in the same area amounts to a grand total of 137,328 horse-power. Is this not a splendid testimonial to the service rendered by a great interconnected power transmission system?



Bean Spray Pump Company's plant at San Jose.

Interconnection and Industry In the East Bay Territory

"Hydro-electric energy for power purposes costs less in Oakland and the Bay District than in any other industrial center in America."

This statement, sent far and wide by the Oakland Chamber of Commerce, undoubtedly voices the general sentiment among manufacturers in what is called the East Bay section of central California. The condition there revealed may be accepted as accounting, in a very large measure, for the extraordinary spread of industrial activity in the territory embraced by Alameda and Contra Costa counties. One has only to visit that section to realize what is taking place. It was estimated two years ago that two new industries sprang into existence every week of the year, and it is claimed since then that the average is even greater.



Morton Salt Company's plant at Newark, Alameda County.

A survey taken by the Oakland Chamber of Commerce in the spring of the present year revealed the existence of 1,055 manufacturing plants in the East Bay industrial district, these plants employing, in the aggregate, 42,190 men and women, having an annual payroll of upwards of $57,000,000, and a total production value of $337,909,692. This survey also showed that the industries of the East Bay district include 110 plants of famous Eastern manufacturing organizations.



Reed Brothers, hospital supplies, Irvington, Alameda County.

Such an industrial growth must, as a natural consequence, result in large increases in population.

That available electric power service supplied by the privately-owned (so called) public utilities has played its part in this as well as other industrial sections of California cannot be doubted. According to Federal census figures, 89 per cent of the electrical energy used by industrial plants in California is provided by central power stations and only 11 per cent comes from generating plants operated by the industries themselves. In the 1926 Year Book of *The Oakland Tribune* the following comment upon the situation appears:

"Power comes into this district from half-a-dozen different directions, from great hydro-electric generating stations hundreds of miles away in the Sierra Nevada mountains. The individual plants are so far apart that no condition which can be anticipated would affect more than a small part of the power supply at a time. Moreover, these central station companies are strong financially and conservatively managed, and are continually building up their generating and transmission capacity years ahead of the immediate demand. Present and prospective industries in this district are, therefore, assured of plenty of power and reliable service, not only today and

tomorrow, but as a permanent prospect."

From the primitive age of the Indian in his last declining chapter; through the fabled era of ease and luxury during the Spanish occupation; viewing the passing of that romantic, colorful period of San Francisco Bay history, when by sailing vessel and covered wagon the pioneers started the flood run of population, which has never ceased, little more than a century has passed. The east shore of San Francisco Bay during these early years developed only along rural lines. Upon the rich, rolling land with its wild grain and pasture grazed herds of cattle valuable only for their hide and tallow. With the then rather fluctuating growth in population of the region, the farming methods improved; and, as flowed the westward stream of the early white settlers, followed by the rush of the days of 49, the agricultural development of the East Bay increased apace. Farming of necessity became more intensified. But in the days of gold the water trail led from San Francisco to Sacramento and the then village of Oakland and her rural attractions were not featured.



Alameda Sugar Company's plant at Alvarado, Alameda County.



Coast Manufacturing and Supply Company's plant at Trevano, Alameda County. Employees' homes in background.



General Chemical Company's plant at Nichols, Contra Costa County.

It was inevitable, of course, that with the increased population of Central California must come the greater development of commerce. The products of Alameda County in time found a greater market. The great fertility of the soil and adaptability for a diversity of crops established it as a rich, desirable territory. The back country, with Oakland as the natural outlet, was a great factor in the appraisal given the district by discovery men. With Berkeley organized in 1873, a number of companion communities sprang up along the shore line, as, for instance, Livermore, Pleasanton, Niles, Centerville, Alvarado, Irvington, Mission San Jose, Warm Springs, Hayward, San Leandro, Piedmont, Emeryville, Albany, Pittsburg, Antioch, Richmond, Martinez and San Ramon, and the East Bay section began to assume some proportions. But the outlook was still agricultural. The vision of a great city had not occurred.

Under the conditions, capital was slow in proffering investment. Industry was needed. Manufacturing for the increasing home market and the eleven western states offered great opportunity. The great

East Bay territory, extraordinarily rich in those characteristics necessary for ideal manufacturing conditions, transportation, water sites, climate, advantageous shipping location, seemed destined to attract only a limited growth because of the lack of that greatest essential in industry, cheap, abundant power. California coal was not adapted. Oil discovered in the eighties was slow in application. Imagine, then, the vision of the future created in the keener minds of that period when in the final decade of the 19th century the development of California water power resources was inaugurated. In 1895 the pioneer plant of Folsom (still in service) was constructed; in 1896 the Rome plant of the Nevada Electric Power Co. was built; in 1898 the Yuba power plant, by the same pioneers in electric development in the West, was completed, and when the possibilities of high-tension transmission (16,700 volts in those early days) were demonstrated, the third plant, Colgate, was constructed to transmit power to Sacramento.

The great possibilities of transmission were then only a vision. These first plants supplied only their own limited fields of distribution. But, with the completion of the Colgate plant, there came the development of what has proven probably the greatest public value in electric transmission, the combining of these plants and operation as a single unit. This was the first step in interconnection of power in which California led and is still leading the world.

At this time another event took place which marked the future for California. There was the demand for hydro-electric power with communities lining the shores of San Francisco Bay. Transmitting power for 160 miles at a necessarily increased and undreamed-of potential voltage, and crossing the straights of Carquinez to convey power to Oakland, was a daring thought. But the men who had dared in the first pioneering, dared in this and the lines and crossing still stand as monuments to their daring.

It was then that the industrial development of Oakland started. It was then that her future was enlarged. The resource so greatly needed was added to those already possessed, thus making for an industrial



Aeroplane view of Columbia Steel Company's plant at Pittsburg, Contra Costa County.

locality with prospects for illimitable expansion.

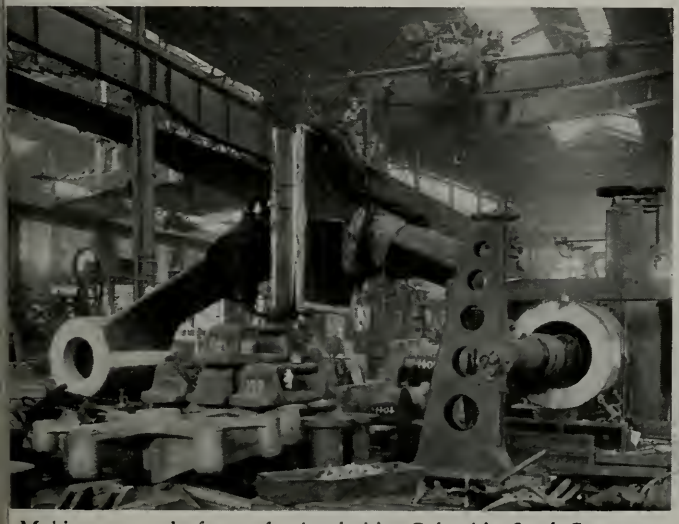
The means for cheap, abundant power had been provided.

What has taken place in the twenty-six years that followed can be pictured. Industries smaller at first, then as the facts regarding the community became more widely known, great national institutions came. Interconnection with its resultant advantages provided the necessary power at economical price and in dependable service wherever and whenever the nature or requirements of the manufacturer demanded. Sites were practical over an extraordinary range of territory in the East Bay. At this day over the entire territory from Antioch to Livermore industries are established and served by an interconnected system which now covers thirty-eight counties in Central California. Industry has been decentralized and rural homes have been made to offer all the comforts of urban life, to say nothing of the advantage to families that comes with wider spread areas. Great diversity of process in manufacturing has been made possible because of the sites thus made available. Some idea of the growth may be gathered from the census of population. In 1900 the combined populations of Alameda and Contra Costa counties stood at 148,243; in 1926, 504,973.



Columbia Steel Works plant in 1910.

These years have proven that our markets for manufactured goods were not misjudged; results have proven that the advantages of location in Oakland and the East Bay territory are real. Local utilization grew to state and then spread over the Pacific Coast and eleven western states. In some products the market has taken a national aspect. The record of exports indicates a worldwide distribution of the products now manufactured in a locality that is so strategically located to serve the world population becoming centered in the West. The exports to foreign countries over Oakland docks amounted to 90,127 tons for the 1925-1926 period, a gain of 112 per cent over the preceding year. Two hundred odd concerns are dealing to some extent with some fifty-nine foreign countries.



Making spectacle frame for battleship, Columbia Steel Company.

Taking "Pacific Service" statistics as a basis of measurement our company's kilowatt hour sales for industrial purposes in the East Bay suburban territory in the year 1915 amounted to 8,600,000, while in 1925, a decade later, they reached 49,300,000, an increase of 475 per cent. The industrial load during the same period rose from 11,500 horsepower to 24,700 horsepower, an increase of 115 per cent.

Following is a description of some of the most interesting of the many diversified industries that

thrive in the East Bay section, extending as it does, from the Oakland waterfront to Antioch and from Richmond to Newark:

Associated Oil Company, Avon. The history of the oil industry in California is one that is generally well known. Particularly in the oil well district where the thousands of borings are indicated by the derricks and where great communities have been built up and supported as a result of drilling operations has the story of oil become a common one. The facts of this industry not so generally known, however, are the refining processes. The great Avon plant of the Associated Oil Company is located on a site the characteristics of which lend themselves admirably to refining and market distribution of the product. Transportation of the oil through pipe lines, the combined trunks of which aggregate more than 6,000 miles, make the location of the refineries at the advantageous locations possible. It is stated that in some cases oil is transported in this means as far as 1,700 miles with various pumping stations en route. The refining process is one in which the use of power is a necessity at every stage. From the point of the first distillation through the action involving the taking off of the different grades of the refined product, every move requires the use of electrically operated pumps to the final storing and then loading for distribution. The total electric load at the Associated Oil Company Avon plant is approximately 8,000 horsepower.

F. E. Booth Company, located in Centerville, is representative of the large number of fruit packing plants advantageously



The F. E. Booth Co.'s plant at Centerville, Alameda County.

located in East Bay region. Power is essential for the conveying and loading operations that form a part of the packing process. While the majority of fruits and vegetables handled are grown in the great agricultural areas of Alameda and Contra Costa counties, some are shipped in for packing purposes. Peaches, pears, cherries, apricots, spinach, peas, tomatoes and berries are handled at the plant and the vegetables, asparagus in the northern end of the district and peas, tomatoes and spinach are grown in quantities to keep the various packing plants in a state of great activity during the packing season. Power required in a plant such as this amounts to upwards of 300 horsepower.

Columbia Steel Corporation, Pittsburg, Calif. Established as a steel foundry in 1910 primarily to furnish the repair parts required in the gold dredging industry, the plant has, by means of aggressive and capable management, grown to the point where it now ranks as one of the outstanding industries of the Pacific Coast. The Columbia Steel Corporation was one of the plants that met energetically the requirements of the war in a splendid manner. Following the war demand, the same energetic management met the problems of readjustment and prepared to meet the growing demands of California and the Coast Territory for building products. The rolling mill operations were started in about 1920 specializing on bars and small sections for concrete reinforcement.

Adequate preparations were likewise made for the Coast expansion by building of rod mill, wire and nail mill, and sheet mill. The



Johns-Manville Company's plant at Pittsburg.

Pittsburg plant is now equipped for the modern economic production of steel castings, bars and other merchant mill sections, wire rods, wire, wire nails and black and galvanized sheet steel.

The output of this character required the constant and economical supply of raw material in the shape of pig iron. Exhaustive surveys developed a location in the State of Utah where proper combination of iron ore and coking coal was located with the result that these coal and iron properties were developed with coke ovens and a blast furnace built at Ironton, near Provo, in Utah. In addition to meeting the pig iron requirements of the Pittsburg plant, the Utah properties developed coke, sulphate of ammonia, benzol, tar and likewise gas for illuminating and heating purposes.

The employment of approximately 1500 men at the Pittsburg plant has brought great development of the community. The location of this plant in Pittsburg initiated the establishment of a community that bids fair to rival some of the larger cities of the State. It is interesting to note that the power requirements of the huge plant are in excess of 15,000 horsepower.

Remillard Brick Company, near Pleasanton. Another type of industry that cheap electric power has made possible. The location of the plant is directly at the source of its raw product. A high grade clay for the manufacture of bricks is execavated near the plant, conveyed to the plant by electric conveyors, making a finished product that is admirably meeting the growing requirements of California building. In this plant alone more than 250 horsepower is required for its operation.

Johns-Manville, Inc., has erected the first unit of its great enterprise at Pittsburg, California. This manufacturer of nationally known products has, in a remarkably short space of time, progressed to a point in the development of the plant that it is at the present time using more than 500 horsepower in electrical energy in the first unit of the plant. Adequate land facilities are available for a manifold expansion.

Continental Salt Company, Alvarado. The salt industry of the East Bay is found in that territory bordering the bay area from Mt. Eden to Alviso. Thousands of acres are involved in so-called "salt farming." The process of elevating the salt water from the bay and through the different grades of evaporation is an interesting one. Again in this process as in others electricity meets the power requirements from the time the salt pumped into the first elevation from whence a gravity travel of upwards of sometimes three miles finally takes the process to the harvesting point. Here at the plant the salt is washed, rechrystalized and ground, graded and packed, all of which is efficiently and economically handled by electric power. An interesting side light of the large salt industries of the East Bay, where millions of dollars are being



Associated Oil Company's plant at Avon, California.

spent in this development, lies in the world-wide shipment of cattle licks made from salt dust.

General Chemical Company. The General Chemical Company at Nichols is an example of one of the great chemical industries that are advantageously located on appropriately convenient sites in the East Bay. Here, from crude materials brought in to the Oakland plant by rail and water from Arkansas, Texas and parts of California, are manufactured sulphuric acid, sulphate aluminum and mixed acid, together with insecticides and fungicides used not only for the great fruit growing areas of California but likewise shipped to all parts of the world.

The products of this chemical company are largely in demand in the oil industry and in the manufacture of paper; also in water filtration. Likewise the mixed acid is used in the manufacture of gunpowder and high explosives. The plant is running at full capacity at the present time with employees numbering more than 200 working on eight-hour shifts. Power is an extremely important factor in the operation of this plant, where the continuity of operation is essential. The electrical installation of the plant involves upwards of 3,000 horsepower with practically constant operation.

Hercules Powder Company. Travelers on the Southern Pacific will recall the statue of Hercules in its beautiful surroundings at the plant of the Powder Company located at Hercules, California. Here in an ideal location for the manufacture of high explosives, with homes and living conditions of the highest type provided for its employees all decentralized, is manufactured a product carried to all parts of the world. It is difficult to disassociate the thought of powder and high explosives at the present time from war, but agricultural use of powder in the clearing of land and improvement of the arability of the soil is creating a constantly increasing demand. So efficacious is the use of explosives for this class of work, together with road building and excavating and construction, that the peacetime demand of this product bids fair to continue the expansion of this great company. What electricity has meant in a plant of this kind is indicated by the fact that upwards of 2,500 horsepower is utilized.

Coast Manufacturing and Supply Company, Livermore. At another plant operating under decentralized conditions made economically possible by the interconnection and cheap power may be found the plant of the Coast Manufacturing and Supply Company. Here the major product is fuses and operating under ideal and practically rural conditions with the employees located in beautiful surroundings a product is manufactured wherein the use of electricity is not only taken for mechanical power, but like many other types of manufacture indicated in this article, electricity is adapted for use in processing, heat treating, etc., in addition to the mechanical power requirement.

The automotive industry has taken root in the East Bay district. Among the world-renowned factories having establishments on the Alameda County shore of the bay are the Chevrolet, Durant, Fageol, Hall-Scott, Willys-Overland and Caterpillar Tractor companies. Within the same area there are other industries bearing names known from end to end of the United States, notably the American Canning Company, Bethlehem Steel Products, Detroit Steel Products Company, General Electric Company, Illinois Wire and Cable Company, Pullman Company, Western Electric Company and Westinghouse Electric and Manufacturing Company. It is stated that more nationally known manufacturing concerns have located in the East Bay territory within the past three years than in the previous ten-year period. Climate, transportation facilities, working conditions and available power are the principal deciding factors, and of these not the least is available electric power.



Continental Salt Co.'s plant at Alvarado.

Industries Spread Through The North Bay Counties

The North Bay counties have become foremost in the State of California in agricultural development. Marin County is noted for its dairy industry, Sonoma County for its fruit and poultry industry, Napa excels with its grape vineyards and Solano County boasts of its fruit products.

This group of agricultural counties, however, is gradually undergoing an extensive industrial development. Railroad and water transportation have brought this extensive territory within easy reach of the bay section with its shipping and railway terminals. This, together with the fact that "Pacific Service" is available over all of the counties, has brought about an industrial growth which would not be ordinarily expected in such a territory.

This year "Pacific Service" is supplying a connected load of approximately 14,000 horsepower in the North Bay region which is entirely devoted to the manufacturing industry. This figure in itself is not remarkable but, rather, the fact that these industries are located in what heretofore was strictly an agricultural territory.

The entire North Bay region is covered with a network of 60,000-volt lines which provide continuous service to both the manufacturing and the agricultural loads. Modern substations have been constructed in the principal cities and towns from which distribution at lower voltages is made. The principal transmission lines are so interconnected that very few interruptions occur. There are three separate and distinct sources of power from which this region may be supplied namely, the Cordelia-Vaca-Dixon connections, the San Francisco connections by cable under the bay near the Golden Gate, and the Snow Mountain Power Company connection to the north with its power house in Potter Valley near the Eel River.

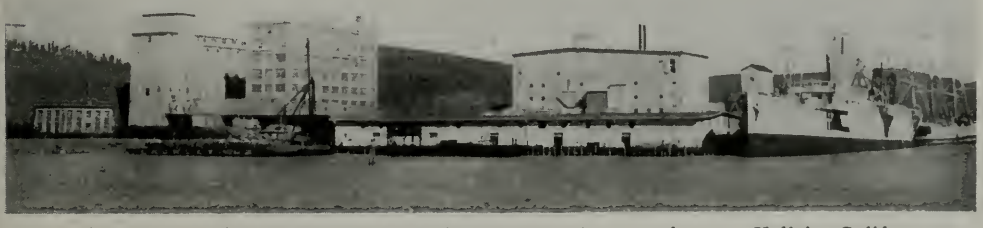
An interesting fact in connection with the industrial development in the North Bay counties is that most of the industries are not directly related to the agricultural development. Many scattered industries over the United States are supported through local agricultural and mining industries, such as the flour mills in the Central States and the steel mills in the Eastern States. The congestion of industries in the larger cities is principally due to the fact that one industry often depends upon others and furthermore the problems of transportation facilities, labor and power have heretofore made it almost necessary for industries to be located in already congested areas.

It is impossible to describe in this issue all of the industries of the North Bay counties; however, a description of a few of the most prominent follows:

Belding-Heminway Company, Petaluma. The Belding-Heminway Company manufactures silk products, with factories located over the entire United States. The factory at Petaluma is the largest west of the Mississippi. It is under the management of J. S. Woodson.

The raw silk is shipped to Petaluma from the Orient. The value of this imported raw product runs into the hundreds of thousands of dollars per year. When the raw silk is first received it is stored in firepoof vaults because of its value.

The mill is the only mill in the Western



The Sperry Flour Company's extensive plant on the waterfront at Vallejo, Calif.

States which completes the entire process in the manufacture of silk products from "throwing" to "finishing." The "throwing" of the silk converts the raw product into what is known as "gum" silk. The "gum" silk in no way resembles the fine silky finish which has made this product so valuable. After the throwing process is completed the gum is removed from the silk, leaving the very fine texture which is so desired. The silk is still in its unfinished form, and before it can be placed on the market the spinning machines convert it into spool silk, embroidery silk and thread for knitting purposes. No weaving is done at the mill as the entire output is in the form of thread. The thread is shipped over all the United States and Mexico and some of it goes to Australia.

The dyeing plant imports most of the materials for dyeing purposes. This process creates the number of bright colors used in present-day wearing apparel.



The floor area of the plant is approximately 30,000 square feet. This area is taken up with storage space, spinning and sewing machines. There are 5,600 spindles in the plant. An average of 200 persons are employed throughout the year. All of the machinery is electrically driven. Most of the machines are driven in groups direct or belt-connected to the motors. The mill has a connected load of approximately 150 horsepower.

Sperry Flour Company, Vallejo. The principal mill of the Sperry Flour Company on the Pacific Coast is located at Vallejo. This industry, although it is directly related to agricultural activity, is an outstanding development in this territory.

The wheat which is shipped to the mill for manufacture into flour and its various by-products comes principally from the two great valleys of California. The location of the mill on the bay makes it possible for the wheat to be shipped by barge over the Sacramento and San Joaquin rivers direct to the mill. Some of the wheat also comes from Washington, Oregon, Idaho and as far as Kansas. The finished product is distributed mainly in California, although a good amount is shipped to the Orient, South America and also Europe.

The capacity of the flour mill daily is 3,600 barrels of flour and 140 tons of mill feeds. The capacity of the feed mill, wherein various feeds are mixed, is 350 tons daily. The grain elevator has a storage capacity of 1,000,000 bushels of bulk grain.

Ample loading and



The Belding-Heminway Company's silk mill at Petaluma, Sonoma County, Calif.

unloading facilities are available at the site selected for the mill. There is track space for 62 cars and docking space for two vessels and two barges at one time. The wheat is unloaded from the vessels and barges by a specially constructed apparatus which will carry 180 tons per hour. The unloading apparatus for the freight cars will carry approximately 100 tons per hour.



Aerial view of the Mason By-Products Company's plant and warehouses at Sausalito.

Some idea of the operation of the plant may be obtained from the fact that the average input at the plant is 100 cars per week with an average output of 80 cars per week.

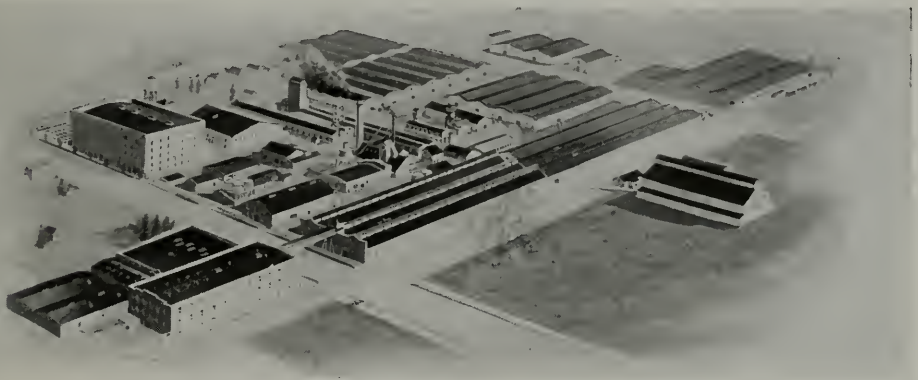
The plant employs approximately 250 people with a monthly payroll of $35,000.

The principal operations of rolling and unloading the various products are conducted through the use of electric power. The total connected load at the plant is approximately 3,000 horsepower and the current consumed is approximately 1,000,000 kilowatt hours per month.

Mason By-Products Company, Sausalito. The basic product for many of our industries is distilled alcohol. Distilled alcohol is used in many industrial processes and is also an ingredient in the manufacture of hundreds of products.

The Mason By-Products Company is one of the outstanding industries in Marin County. The plant is designed for the conversion of fruit and vegetable products into industrial alcohol. The principal source of raw material used in the plant is the Hawaiian Islands, from which thousands of gallons of molasses are shipped annually. In addition to this source of raw material the plant makes extensive use of California fruits.

When fruit is used in the manufacture of industrial alcohol it is shipped to the plant in box cars where it is unloaded and ground. It is then mixed with water and pumped into large vats of 25,000 gallons capacity, where it is allowed to ferment and the usual



Kullman-Salz & Co.'s tannery at Benicia, Solano County, Calif.

process of making industrial alcohol from molasses is used. The fermentation is brought about by means of a yeast growth in the vats. After fermentation the liquid is pumped into the distillation towers which have a capacity of 25,000 gallons per day. These distillation towers are the largest in the country. In the distillation towers the steam is taken off direct to the still while the remaining solid matter runs into tanks, where is is allowed to dry and subsequently sold for fertilizer.

The annual output of industrial alcohol is 4,000,000 gallons. The alcohol, as well as the numerous by-products, is shipped all over the United States. The principal application of electric power is in the form of motors. Motors varying in size from 1 horsepower to 100 horsepower are used to pump and mix the liquids,, grind the fruit, etc. The total connected load at the plant is approximately 1,026 horsepower.

Carson Glove Company, San Rafael. Scattered over the North Bay counties are six different factories engaged in the production of gloves, shoes and other leather products. Typical of these plants is the Carson Glove Company of San Rafael and the California Glove Company at Napa.

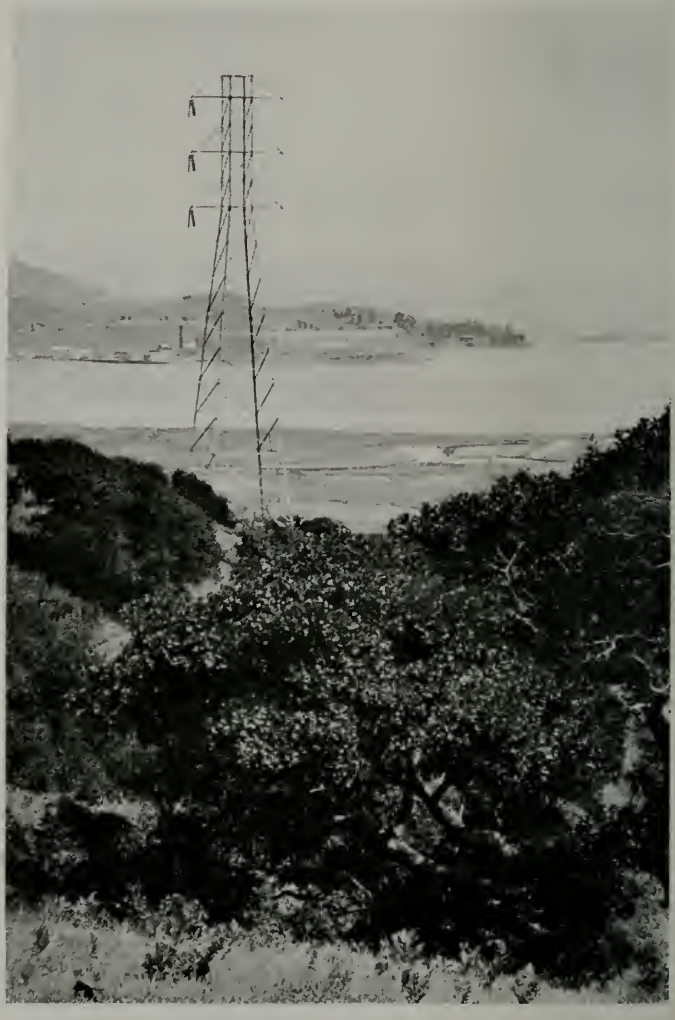
The Carson Glove Company at San Rafael came to this city after the plant was destroyed in the San Francisco earthquake and fire of 1906.

The hides for making into gloves are secured from the Western States. The principal hide used is horse hide. The hides, after being received, are softened and dyed the desired color and then cut and sewed into gloves and other leather products. There are approximately 35 workers at the plant and the daily output is approximately 30 dozen gloves. The principal line produced by the factory is workmen's gloves. The value of the annual product is $30,000.

The principal application of power at the plant is for driving cutters and sewing machines.

The California Glove Company, Napa. The California Glove Company at Napa, another typical leather goods factory, secures most of its materials from the Balkan States, Africa, Siberia, Turkey, Arabia and Russia. The finished product is distributed in all of the Western States and also China and Japan.

About 288,000 pairs of gloves are turned



High-tension tower bearing "Pacific Service" across the Marin foothills toward San Francisco Bay.

out each year and the daily output is approximately 1,000 pairs. There are 125 employees in the plant.

All of the machinery is operated electrically.

Rex Spray Company, Benicia. The Rex Spray Company was established in Benicia in 1898 and its products of spray mixtures are used over all the Pacific Coast. Spray material for insecticides and fungicides, household and agricultural purposes is manufactured.

The raw products, oil and sulphur are shipped from the east and from the various oil fields in the State of California.

Rex Spray is the celebrated home of "flytox" which is being widely used as a household disinfectant.

Electric power is used extensively in the plant for driving pumps and mixing the various ingredients employed in the manufacture of the spray.

Mare Island Navy Yard and the Benicia Arsenal. The Mare Island Navy Yard and the Benicia Arsenal are both located in Solano County. Both of these institutions are extensive users of power.

The Navy Yard is the largest on the Coast. The principal operation carried on at the Yard is the maintenance of the Pacific Fleet and the construction of some of the smaller naval vessels. The famous battleship "California" was constructed at Mare Island.

The connected load at the Navy Yard is approximately 4,500 horsepower. Power is used for driving motors and for numerous heating processes.

The Benicia Arsenal was established in Benicia in 1848 and has kept pace with modern industrial development through the continuous installation of new machinery since the date it was first placed in operation.

The arsenal is principally engaged in the maintenance of artillery and infantry equipment of the 9th Corps Area.

Electric power is used in the huge machine shop, woodwork shops, tractor repair shops, arms repair shops, etc.

There are 75 civilians employed at the arsenal, the remainder of the employees being Army men.

A connected load of approximately 800 horsepower is in use at the plant.

At the present time the arsenal is under the command of Major Partridge.

G. W. Hume Company, Benicia. G. W. Hume was the first man in the State of California to embark in the canning business.

The year 1864 was when the first cannery was started in operation, the only thing being canned was fish.

The Hume Cannery at Benicia is one of the oldest, if not the very oldest, cannery in the State of California.

Asparagus, cherries, apricots, plums, peaches, peas, tomatoes and fruit salad are the fruits and vegetables canned.

The greatest portion of the canned goods is sent to England and the Atlantic Coast.

A good day's finished run is about 90,000 cans.

Everything is operated electrically.

During the busy season in the early summer, about 325 men and women are employed there.

Kullman-Salz Company, Benicia. The Kullman-Salz Company operates the largest leather tannery west of Chicago. The finished product is sold under the trade name "Monarch of the Oaks." The principal product of the tannery is sole leather, but collar leather is also manufactured. The finished product is shipped to all parts of the United States and also many foreign countries. The tannery handles on an average of 500 hides per day, which are shipped to Benicia from all over the United States and South America. The principal agent used in tanning is California oakbark from Humboldt County. Approximately 250 people are employed at the tannery throughout the year. The connected load at the tannery is 800 horsepower. Mr. Salz states: "The availability of a dependable source of electric power has been a very important factor in the development of the plant."



The Pacific Gas & Electric Company's high-tension substation at Sausalito, on the Marin shore of San Francisco Bay.

March of Industry Through California's Golden Valleys

A striking illustration of the modern trend toward decentralization of industry in California is found in the intrusion of the factory into the once peaceful solitude of the great valleys that stretch, between coast and mountain ranges, the length of our golden state. Of these two of the greatest prominence are the valley of the Sacramento and the valley of the San Joaquin.

The development of these valleys was small indeed until but a few years ago. Men whose memories carry them back to early days say that the Sacramento and San Joaquin valleys were, for the most part, planted to hay and grain and the necessity for irrigation did not take hold of the farmer until fruit cultivation became the vogue. As it was progress was very slow until the electric motor came into fashion. Today the wonders of rural electrification have been spread far and wide, and just a year ago readers of the PACIFIC SERVICE MAGAZINE were told how "Pacific Service" had blazed the trail for others to follow.

From carefully gathered statistics at that time we learned that of the power used on the farms in California electric motors were responsible for 42 per cent, and that the percentage was increasing every day; that the average cost per horsepower hour for all farm power used in the United States was 19 cents, whereas in California, due largely to the low cost of electric power, the average cost was 9 cents. It was further found that the average crop value per acre of improved land of the United States was $29.00; in California $53.00; that the California farm operator utilized over four times as much power on his farm as the average farmer in this country and that his net income was larger than that of the farmer in any other state and over twice the average for the United States as a whole; lastly, that the amount of electric energy used in California agriculture at the time of publication was 554,000,000 horsepower hours per year; more energy than that annually required for operating all of the seeding and planting machinery on the farms of the United States; more than five-eighths of the power used to harvest all the crops in this country.

So much for rural electrification. And, where there is raw material the factory is sure to come eventually, provided the necessary factors in industrial location, namely, climate, power, fuel and water, labor supply, transportation facilities and accessible markets, are favorable to enterprise. These factors have determined the location of many triving industries in California in recent years, and of these factors by no means the least is the supply of cheap and dependable power.

Early in 1925 the Sacramento Chamber of Commerce made arrangements with the Research Department of the California Development Association to conduct an industrial survey of Sacramento and its tributary regions for the purpose of determining the opportunity and problems of manufacturers in that territory. Investigation was made of existing industries, study of the



The Yuba Manufacturing Company's plant at Marysville, California.

economic factors determining the location of various types of industry was made, data on the resources and development of the region were gathered as well as supplementary information on business, governmental and social conditions. The survey took in not only the city of Sacramento but the area tributary thereto, including twenty counties of northern California, an area of more than 26,000,000 acres. The survey has recently been completed and affords much interesting reading.



Union Ice Company's plant at Woodland, California.

Within the city and suburbs of Sacramento, as disclosed by this survey, there are 417 manufacturing establishments. During the year of 1924, as disclosed by this survey, the products of these establishments were valued at $48,301,500. Raw materials valued at $25,418,354 were processed by these plants, to which a value of $22,883,146 was added by manufacture. These plants include canning and preserving of fruit and vegetables, flour and milling feed plants, rice mills, planing mills and other industries allied with products of the natural resources of the area named. Dealing with electric power supply as one of the contributing factors of industrial location in this area, the report finds as follows:

"Development of hydro-electric power in the area designated as economically tributary to Sacramento has been extensive and rapid during the past decade, and remaining undeveloped hydro-electric resources are being exploited as rapidly as the demands for power warrant the construction of dams and generating plants. The capacity of existing hydro-electric plants in this area is reported as 509,270 k.w. A large surplus of electric power over and above the amount consumed in the territory is carried by the high voltage transmission lines of existing companies to other sections of the state."

For details concerning the distribution of industries throughout this area the reader is respectfully referred to the survey itself. Suffice it to say here that the report shows a gratifying increase of the manufacturing industry throughout an extremely fertile region and one of diversified resources.

Within the "Pacific Service" territory industries in the Sacramento Valley extend from Redding to the bay of San Francisco and from the bay eastward to the foothills lying below the High Sierras. Taking the last named section first, the packing-houses of the new Newcastle district have made that unpretentious locality the greatest fruit shipping center in the world. Coming nearer to the city of Sacramento, the Pacific Fruit Express Company has established at Roseville the largest ice plant in the world with a connected electric load of approximately 6000 horsepower. On the Roseville side on the way up to Redding, factories now dot the landscape. At Marysville the Yuba Manufacturing Company operates its giant plant, and not only is electricity installed here to the extent of 665 horsepower but all this company's dredges are now electrically operated. As



Modern dredger, electrically operated, on American River near Folsom.

an example of progress made through this modern developer, it may be stated that the first successful gold dredge built in Oroville was operated by steam power, but this was later converted to electric, and the installation was 150 horsepower. One of the modern dredges operating on the Yuba river today has an installed electric motor capacity of 1176 horsepower. Some idea of what this means may be gathered from the fact that the capacity of the former dredge was about 1200 cubic yards per day while the capacity of the latter is approximately 15,000 cubic yards per day. Furthermore, the company's general manager volunteers this statement: "Large operating economies have been accomplished by modern machinery."



Pumping plant, Reclamation District No. 108, Yolo County, Calif.—3000 horsepower capacity.

"This company's plant was first built at Marysville to supply dredging equipment for the Oroville, Yuba and Folsom districts. Today its ouput enjoys world-wide distribution. Dredges built by the company are operating all over the Pacific Northwest, including Alaska, and in foreign countries its dredges are found operating in Central and South America, the Philippine Islands, and in Europe as far east as chill Siberia.

Lumber mills are found on this side of the Sacramento Valley, and the Diamond Match Company's plant in Chico is a landmark, so to speak. In the district from Redding north the copper smelting industry stands prominent, while coming down the west side of the valley one finds manufacturing industries closely related to the products of the soil. Rice mills and cotton gins are attractive features. It may not be known that on October 13th of this year the first bale of cotton was ginned at Hamilton City in the new plant of the Valley Cotton Gin Company. During the year to come cotton grown on about 2000 acres in Glenn County will be ginned at the Hamilton City plant.

Another new industry for the northern part of the Sacramento Valley is the plant of the Northern Basket Company, located at Red Bluff. Although operations commenced so late this year that most of the larger packers had already purchased their requirements the plant put out 20,000 baskets per day. This can be materially increased with the present machinery which is electrically operated. The company has its own veneering plant at Anderson. To pack a carload of green fruit 4000 baskets are required.

Next in order of progress comes Corning, where the Maywood Packing Company operates, its chief industry being the processing of olives of various varieties. Nearing Sacramento the Globe Flour Mills and the Union Ice Company plants in Woodland are illustrative of the march of industry. Then come the city and suburbs of Sacramento itself, with 417 manufacturing industries in actual operation.



The Globe Flour Mills at Woodland.

One industrial undertaking of magnitude at the lower end of the valley is the plant of the Pacific Portland Cement Com-

pany in the foothills southeast of Suisun. This plant was originally established in 1902, the chief reason for selecting the site being that it was handy to the lime stone quarries and clay pits. Electricity has developed this into an enormous undertaking, which when running to capacity turns out 4200 barrels of cement in a day and is taking 4000 horsepower of electricity and 350 human operatives to do it.



The Pacific Portland Cement Company's great plant in the foothills back of Suisun.

This industry is really worth while for more than one reason. The mill buildings covering several acres in extent are surrounded by a village of some sixty neat model homes, with paved and lighted streets and sewer, water and electric distributing systems installed. The conveniences include a hotel, store, hospital, school and other modern adjuncts of a complete modern town. Some of the plant's employees work small ranches in the neighborhood.

In this extremely superficial sketch of industry in the Sacramento Valley nothing has been said of rural electrification. This, it will be remembered, was comprehensively dealt with in PACIFIC SERVICE MAGAZINE a year ago. It may be said, however, that the electric pumping plants are doing yeoman service and are increasing in horsepower capacity. In Reclamation District No. 108 there is a plant with an installed capacity of 3000 horsepower, while in Reclamation District No. 1500 the installed capacity is 4800 horsepower. These plants between them drain an area of approximately 100,000 acres on opposite sides of the Sacramento river in Yolo and Sutter counties. Another installation worth mentioning is the 1650 horsepower plant of the Sutter Basin Company.

It can be readily seen that to not only cheap but dependable electric power service many of these industries owe their uninterrupted activity. The valleys of California are particularly fortunate in this respect, for the reason that the interconnected high-tension lines from the various mountain power plants traverse their length upon their errand of service to the main centers of population and trade.



Pacific Gas and Electric Company's high-tension substation in the Sacramento Valley, near Dixon, whence the electric power from the Pit River region is distributed to various industrial centers.

Electricity Replaces Steam at Santa Clara Water Works

Four steam boilers and three large duplex steam pumps, one of which operated as a condensing unit, have recently been replaced by three electrically operated centrifugal pumps in the Santa Clara Water Works.

At Santa Clara the electric light and power distribution system, the gas distribution system and the water supply system are all municipally owned and operated. The city purchases electricity and gas at wholesale rates from "Pacific Service" for distribution to its local customers. Water for commercial and residence customers and for fire protection, irrigation, etc., was formerly drawn from a ground level collecting reservoir and forced directly into the distribution system by steam-operated pumps. The small amount of reserve capacity available for pressure for the entire system consists of not more than 100,000 gallons of water stored in a steel tower tank. This amount of supply will handle the ordinary requirements of the city for not more than thirty minutes and might be consumed in ten minutes' time in case of fire.

It is essential, therefore, that adequate and practically continuous electric service be available in order to meet the demands of the Fire Underwriters in the matter of continuous fire protection. It is particularly significant that the service afforded by the Pacific Gas & Electric Company, which is available from two sources, was considered adequate for fire protection for the city of Santa Clara without the necessity of a steam standby.

The original steam plant is no longer operated, although it has not been completely dismantled. It had a capacity of about 2000 gallons per minute when working under full head. The new electrically operated plant, consisting of three single stage American Well Works Company centrifugal pumps direct coupled to General Electric Company motors, will supply 50 per cent more capacity than the old steam equipment. The pumping units may be operated in parallel for ordinary pressures of about fifty pounds and may be operated in series to provide 100 lbs. pressure for use during fire. The plant has on several occasions been operated for fire purposes and has successfully met all requirements.

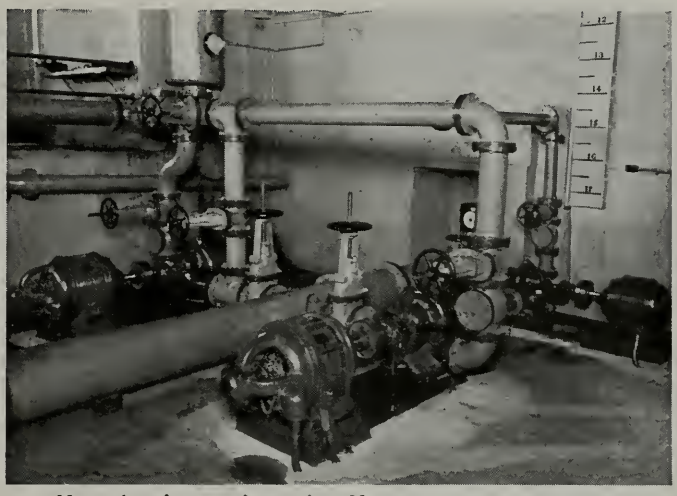


The municipal water works at Santa Clara.

The two 6-inch pumps shown in the photographs are driven by 50-horsepower slip-ring type motors and will each deliver 1250 gallons per minute against a 120-foot head at an overall efficiency of 70%. The 4-inch pump shown in the background is operated by a 25-horsepower motor

and will deliver 600 gallons per minute against a 120 foot head at 65 per cent efficiency. Electric power to the pump motors is separately metered and the quantity of water pumped is indicated and recorded by a Sparling flow meter shown in the background.

In an accompanying illustration the old condensing type steam pumping unit is seen still in place. Two smaller and similar units were removed when the electric units were installed. Note the small amount of space required and the neat arrangement of the electrical equipment in the background to replace the large amount of steam pumping and boiler equipment which performed similar service.

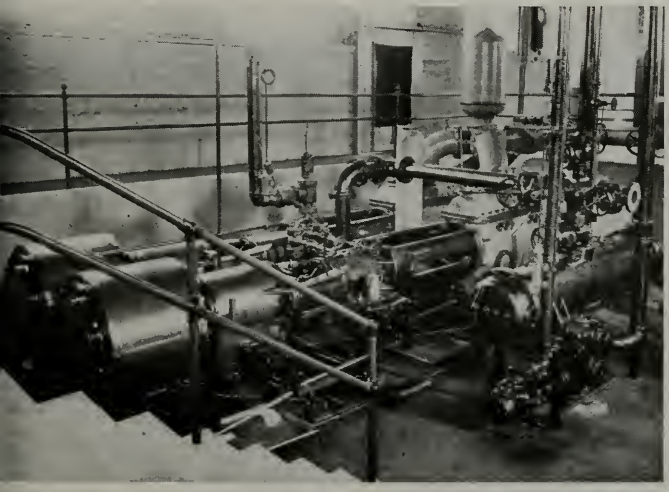


New electric pumping units. Note compact arrangement.

The "Pacific Service" sales department assisted the city of Santa Clara in developing some facts as to operating costs of the old steam plant and in laying out and purchasing the new electric units. Mr. J. I. Dixon, general superintendent of utilities systems at Santa Clara, did an excellent piece of work in installing and connecting the new plant.

There are other towns larger and smaller than Santa Clara now using "Pacific Service" to handle their water supply. Some of them depend upon it exclusively, others have retained their old steam plant as a stand-by and one or two of the larger cities have installed gas engine plants at nominal expense for emergency purposes. San Jose is an example of the latter class and we are informed they have not been required to fall back on the stand-by plant since it was installed. It is turned over occasionally to be sure that it is in good working order.

"Pacific Service" in towns where it is used has reduced operating expenses in amounts varying from 20 to 50 per cent. Old steam plants have been cleared out and the space used for storage or the buildings have been entirely removed. The operating forces at both electric and gas plants have been reclassified. Service to customers is uniformly better. The few remaining towns should study their operating costs for power separately and apart from other expense and compare the cost of private plant operation with that of purchasing electric power to do similar work under similar circumstances. The operating costs are in favor of purchased power.



A part of the old steam installation.

The Financial Side of "Pacific Service"

Following is a condensed preliminary statement of the Company's earnings for the nine months ended September 30th, 1926, compared with the same period of the preceding year:

	9 Mos. Ended Sept. 30, 1926	9 Mos. Ended Sept. 30, 1925	Increase
Gross Revenue, including Miscellaneous Income....	$37,954,857.37	$35,862,463.46	$2,092,393.91
Operating Expenses, Taxes (including Federal Taxes) and Reserves for Casualties and Uncollectible Accounts	22,130,794.53	21,575,228.95	555,565.58
Net Income	$15,824,062.84	$14,287,234.51	$1,536,828.33
Bond Interest and Discount.....	6,258,125.66	5,693,275.94	564,849.72
Balance for Depreciation and Surplus.....	$ 9,565,937.18	$ 8,593,958.57	$ 971,978.61

The gross revenue of $37,954,857 was the largest in the Company's history for any similar period. The rapidity of the Company's growth is indicated by the fact that this nine months' gross was greater than the revenue for the full year 1921. There appears little doubt that total gross earnings for the current year will exceed $50,000,000 in spite of the fact that, except for the two reductions in gas rates which were made effective on October 22nd and November 26th, 1925, as a result of lower prices paid for fuel oil, the Company's gross in the first three-quarters of this year would have been approximately one and one-fourth millions of dollars greater than was actually the case.

Sales of electricity in the nine months ended September 30th, 1926, aggregated 1,123,681,788 kilowatt hours, an increase of 11.93% over the corresponding period of 1925, while the volume of gas sales amounted to 12,998,167,200 cubic feet, an increase of 7.93%.

A striking feature of the Company's operations during the current year has been the very rapid growth in sales of electricity for commercial and residential heating and cooking, which, in the nine months ended September 30th, showed an increase of 35.48% over the corresponding period last year. This increase is largely due to intensive sales effort directed particularly to the additional loading of existing lines. It is also noteworthy that every other major division of the Company's electric department sales shows a very satisfactory growth, with the exception of a small recession in the volume of sales to the mining industry.

At the close of September there were 858,355 active meters in service on the Company's lines, an increase of 44.657 since the first of the year. This is almost 50% greater than the net addition of consumers in the first nine months of 1925, when 30,844 additional meters were placed in service.

He Who Wants Something for Nothing Usually Gets Nothing for Something

Under the above caption an investment house a few days ago reproduced a list of the security holdings of an Oregon farmer who died recently.

This list comprised 8822 shares of the common stocks of eighteen companies, chiefly mining concerns. These stocks represented the savings of a lifetime. Their par value was $11,431. Their market value was nil.

In this connection we venture to reiterate the advice which we have previously given in these columns—"Don't be misled by alluring promises of quick profits and large returns; and if in doubt, consult a reputable broker or your local banker."

An incident emphasizing the necessity for careful scrutiny of prospective investments was recently brought to our attention. One of our stockholders, who happens also to be a professional accountant, was approached by a stock salesman offering for sale the preferred stock of another public service corporation. The prospective customer mentioned that he held some Pacific Gas and Electric Company preferred stock, whereupon the salesman stated that the utility in which he was endeavoring to interest his client earned its preferred stock dividends by a considerably greater margin than did this Company, in spite of which he was able to offer the stock for sale at a price yielding the purchaser a higher return than that received from Pacific Gas and Electric Company preferred. He produced a comparative statement of earnings, which appeared at first sight to support this contention.

Our stockholder however being, like all true accountants, of an inquiring, not to say suspicious turn of mind, took the trouble to analyze the figures presented, and pointed out that the purported earnings on the preferred stock of the other utility were arrived at before any deduction for Federal taxes or for depreciation reserve, both of which are properly shown by the Pacific Gas and Electric Company as charges coming ahead of preferred stock dividends. In the year 1925, this Company set aside an aggregate of approximately five million dollars for these two items before showing the balance available for preferred stock dividends. It was easily demonstrated that adequate provision for these items on the part of the other utility would have reduced its surplus for preferred dividends to such a degree that the advantage in favor of the Pacific Gas preferred was overwhelmingly apparent, and the salesman, with the remark that he was not going to try any more comparisons on accountants and other such inquisitive people, withdrew in some confusion.

As a matter of fact, the purchaser of securities, particularly those which enjoy an active market, gets about what he pays for. Market prices really represent, generally speaking, the composite judgment of a multitude of investors. If a bond or a stock is offered at prices yielding an abnormally high return, it invariably proves that the security is largely speculative in nature, and the earnings upon which the investor's return is based, more or less uncertain. In the present market, for example, the average high grade utility bond yields approximately five per cent, or possibly even less. In spite of this, it is still possible to purchase certain bonds which yield at the market price as high as eight or even ten per cent upon the investment. The very fact of this high yield indicates that the continued payment of interest is, to say the least, in jeopardy, and the purchaser of the latter class of securities is very liable to find himself in a position where, instead of getting a high return from his investment, he receives no return at all. The plain truth is that safety in investment and an abnormally high yield do not go hand in hand, and in the long run the man who invests in securities of established merit and who is satisfied with a reasonable return upon his money is almost invariably better off financially than the seeker after high yield. A writer in a recent issue of *Harper's Magazine* graphically sums up the situation in the following words:

> "It is a fact, not generally recognized apparently, that most substantial fortunes have been accumulated slowly, and by intelligent, consistent, and careful work. Few people have grown rich overnight, which may be discouraging but it is nevertheless true, and it is also well established that those who seek profits incommensurate with what they have a right to expect practically always come to grief. We read of the man who wins the big lottery, but we hear nothing of the hundreds or thousands who bought tickets and lost their money. The winner, of course, 'made a killing,' and his experience is news and is broadcast all over the world. Similarly we read of fortunes made in a short time in oil, or real estate, or in the stock market, but did you ever stop to think that the reason the newspapers print such stories is because they happen so seldom? If you can break the bank of Monte Carlo you'll be famous, but if you go broke yourself scarcely anyone will even listen to your story, which will be like that of thousands of others. So it is with investments. If you can speculate, and win, you're a lucky man, but if you play the game safe, and do not expect too much, the chances are you'll be independent some day, even if you never are rich."

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVI OCTOBER, 1926 NO. 10

The current issue of PACIFIC SERVICE MAGAZINE is mainly devoted to an exploitation of industrial growth throughout the "Pacific Service" territory, with particular attention to rural industry as a thing apart from the industrial activity noticeable in the major centers of population.

"Interconnection and industry" may be said to be the watchword of territorial progress and development today. For, it is undoubtedly due to the interconnection of service transmission lines, both electric and gas, that the manufacturing industries are spreading over sections of territory that were marked in the beginning for nothing more than agricultural employment.

The opening article in the current number dwells upon the trend toward decentralization of industries through interconnection. The article shows how the beginning of interconnection was the tying in of occasional hydro-electric power plants with steam-electric generating plants for joint service in a particular electric manufacturing and distributing public utility; then, from that came a further step toward interconnection in the general tying in of all the transmission lines of a particular public utility into one comprehensive service, where, in the time of need, one subsidiary part of the system might draw upon another, and so forth. These, indeed, were undoubtedly the beginnings of what is now known as interconnection.

More has been achieved in recent years. About six years ago the electric transmission lines of the Pacific Gas and Electric Company were joined north and south to contiguous systems for the common service and welfare, and now there is an interconnected transmission system which reaches from the Cascade mountains of Oregon on the north to the Mexican border line on the south and from the Bay of San Francisco east clear over the Sierras into the State of Nevada. That is the kind of interconnection to which we refer today when we speak of the economic and social benefits that are believed to have been afforded rising communities through the availability of cheap and dependable power.

Lord Rothermere, a famous publicist who conducts a chain of English newspapers left by his illustrious brother, Lord Northcliffe, made a particular investigation of the progress of the electrical industry during a recent visit to the United States. Upon his return home he analyzed the situation in this country in the following terms:

"The economic welfare of the United States is based more than anything else upon the fact that she has 29,000,000 horsepower of electric power established in her factories, a force that is estimated as the equivalent of 290,000,000 workers. Each center of population in the United States receives its power from a single producing organization, which is generally linked, in its turn, with similar enterprises in the same range of territory for the elimination of wasteful duplication and the reduction of overhead charges."

Lord Rothermere found, first, that electric power is the secret of the general prosperity of the American people, that to it more than to anything else they owe the fact that they have no overpowering unemployment problem and possess the largest measure of the comforts and luxuries that give enjoyment to life; second, that a great contributing factor to the present wide distribution and low cost of electric service in the United States is the unification and interconnection of electric generating and distributing systems.

Unquestionably the State of California today presents a vivid illustration of the effects of an evenly distributed power supply. "Unified interconnection service in California is proving an incentive for the decentralization of population and silently and effectively working a revolution in the industrial life of this state." The quotation is from a recent address by our company's president, Mr. Creed, who, himself personally interested in large industrial enter-

prises, has made the industrial situation in this section of the country the subject of close analytical study. He found that for many years previous to interconnection population in rural territories had been decreasing more and more, while, at the same time, increasing within the cities to such an extent that continued undue centralization of population in urban communities had become a menace to the well-being of both city and country; therefore, any development serving to stimulate rural life or advantageously to rearrange population was deserving of both support and encouragement. In the past manufacturing plants, save in a few cases in which closeness to raw material was the controlling factor, had generally located in cities in order to secure convenient and reliable central station power. If they located outside of the city, they had to have their own power plants, which was so often uneconomical, and there was the added disadvantage, amounting almost to a calamity, of having to shut down a whole industry in case of trouble.

With the creation of interconnected hydro-power lines running primarily from the hydro-generating plants in the mountains to the cities loads could be tapped en route for industries located outside the cities. This offered industry the advantage of cheap power anywhere and the interconnection of transmission lines insured against interruption of service. Thus the problem of power supply in rural and suburban territory was solved. Many industries have taken advantage of the opportunity presented to them. All of the major California companies are building up new and increasing industrial loads in sections lying beyond the crowded areas of the cities. These outside industries secure ample space for their manufacturing operations at lowered costs, and with provision for future expansion at little expense. Natural light and ventilation may be provided and buildings less expensively constructed, so that real advantages may be secured that make for economy of manufacturing.

Added to these advantages, of course, there is the social condition of the employee. Where he once lived in a tenement or closely-packed apartment house he now enjoys a residence in his own separate home with a garden and, perhaps, fruit trees and poultry to add to his greater enjoyment of life. He is owning his own home in the great majority of cases and is enjoying the feeling of freedom that his former existence did not afford. All the home conveniences of the city are brought into the rural district, even to its amusements. On their side, the cities are not harmed, for they will keep their share of industrial activity while receiving the trade benefits of the rural communities surrounding them.

With regard to gas, high-pressure has solved the transmission problem to so satisfactory an extent that now rural communities are supplied with this hundred-year-old but still active commodity from central generating stations. The advantage to the factory or other industrial enterprise having need of this unrivaled heating agent cannot be gainsaid. But it is with cheap and available electric power service, made dependable by the interconnection of high tension transmission lines, that this issue of PACIFIC SERVICE MAGAZINE has most to do.

California is the third state of the Union in total output from electric plants and first in output from hydro-electric plants. With 3.5 per cent of the total population, our state produced more than 9 per cent of the electric power generated in the United States during the year 1925. New York, with 9.8 per cent of the population, produced 15.6 per cent of the total power, and Pennsylvania, with 8.2 per cent of the population, produced 9.9 per cent of the total power. It will be seen, then, that of the three states which produce the largest percentages of power California is responsible for more power in proportion to her population than either New York or Pennsylvania. The consumption of electricity in California is nearly as great as that of France or Italy, both of which countries have a population ten times greater. It is also approximately the same as the combined consumption of Denmark, Switzerland, The Netherlands, Hungary, Poland, Latvia, Greece, Roumania, Turkey and Sweden, though the latter group has a population of 93,000,000 as compared with approximately 4,000,000 for California.

The United States Geological Survey in a report dated August, 1925, shows that of the potential water power resources of the United States there is in California 4,603,000 horsepower available 90 per cent of the

time, and 6,674,000 horsepower which would be available 50 per cent of the time. A later report on developed water power shows that in plants of 100 horsepower or more there is 1,834,980 horsepower of hydro-electric plant capacity installed. This includes public utilities, municipal and manufacturing enterprises and comprising 16.5 per cent of the total developed water power in the United States.

Owing to interconnection of transmission lines which traverse the state, feeding power to hamlet and farm on their way to the large centers of population, there are in California more farms receiving electric service than in any other state in the Union. The United States Bureau of Census, in a report as of January 1, 1925, shows that California is one of the few states showing an increase in the number of farms during the period dating back to 1920, the increase for California being 15.9 per cent as compared with a decrease of 1.2 per cent for the United States as a whole. Undoubtedly this showing is due to rural electrification which by aiding intensified farming tends to increase the number of farms by decreasing the acreage necessary to produce a living return.

In California factories, stores, homes, railroads and farms consume 20,000,000 kilowatt hours every working day. Four-fifths of this power is supplied by hydro-electric plants, of which there are 107 in the network of interconnection. All pour their output into the power pool. If one plant should fail another is ready to take its place. During the water shortage in the southern part of the state in the year 1924 the utilities in the northern portion, including Oregon, released power in order to supply the deficiency.

There are in the State of California today more industrial power customers than in any other states. California, with 97,850 industrial power customers, has 75 per cent more than New York, with 55,800, which state ranks second. The next three ranking states are: Illinois, with 42,150; Pennsylvania, 38,000; and Ohio fifth, with a total of 25,530 industrial consumers.

In California the manufacturing plants are nearly 84 per cent electrified and central stations furnish 89 per cent of the energy consumed by them. This state is pre-eminent in the extent of its industries being electrified, as well as to the high percentage of this load being carried upon central stations.

Concerning the part played by "Pacific Service" in this industrial development in various parts of its territory, our company's records show that the annual kilowatt hour sales for industrial power in South San Francisco have increased from 3,522,000 kilowatt hours, during the year 1915, to more than 28,000,000 kilowatt hours for the year ending December 31, 1925. This represents an increase of 678 per cent during the ten-year period. The industrial load during this period has increased from approximately 4,000 horsepower to 15,700 horsepower or an increase of 272 per cent.

The growth of industry in the suburban territory of Redwood District during the past ten years has been one of progress. The Redwood District comprises all of San Mateo County, while the following figures comprise only the territory outside of the incorporated cities and towns.

The total sales for industrial power during 1915 were 407,287 kilowatt hours, while the sales in 1925 were 16,818,781 kilowatt hours, an increase of 4,029 per cent. The industrial load increased from 1,005 horsepower in 1915 to 6,900 horsepower in 1925, which is an increase of 591 per cent for the ten-year period.

The territory outside of incorporated places in the San Jose District does not show the same rate of growth as the suburban area in the Redwood District. The increase in industrial power sales for the last decade was 89 per cent. The kilowatt hour sales for 1925 were 32,300,000 as compared with 17,100,000 during 1915. The industrial load increased from 12,500 horsepower to 15,300 horsepower during the same period, an increase of 22 per cent.

The growth of industry in the East Bay suburban territory, which contains large industries located near but outside the incorporated cities comprising this division, is interesting. The area included is the portion surrounding such places as Albany, Antioch, Concord, Martinez and Pittsburg. As an illustration, several large users of power, such as the Columbia Steel Company, are located outside the city limits of Pittsburg.

So much, then, for interconnection as the guiding star of industry.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 850,000 CONSUMERS OF

GAS + ELECTRICITY + WATER + STEAM

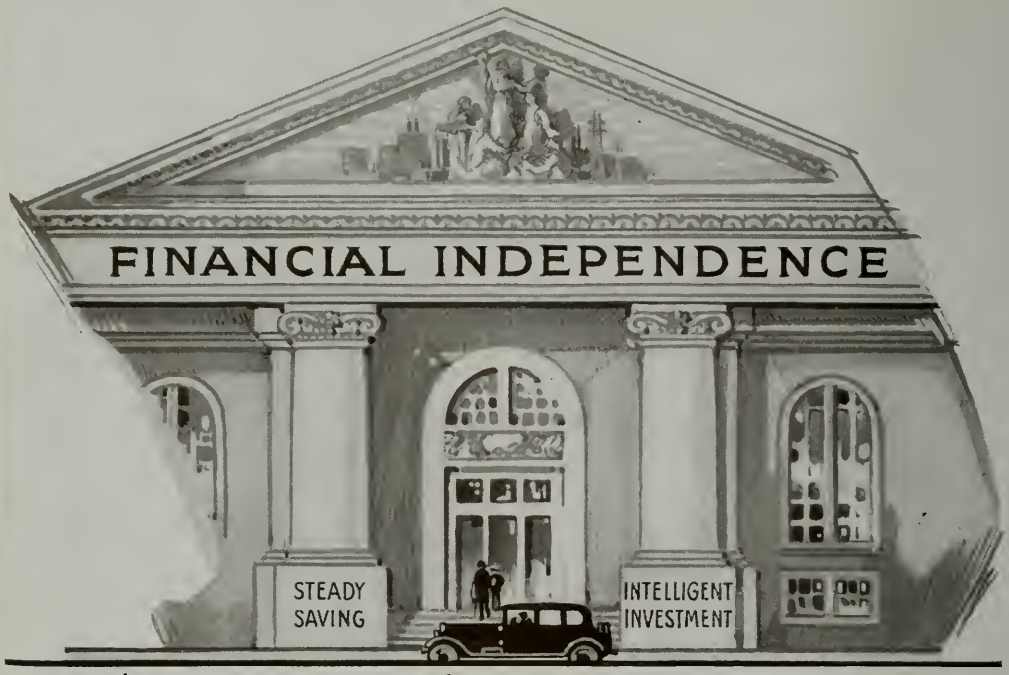
2,472,404 Total Population Served in Thirty-eight of California's Counties

CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL	
	No.	Population	No.	Population	No.	Population
Electricity	248	1,650,294	48	218,170	296	1,868,464
Gas	70	1,660,800	3	18,202	73	1,679,002
Water (Domestic)	24	90,800	6	19,550	30	110,350
Railway	1	105,000	.....	.....	1	105,000
Steam Heating	2	1,003,000	.....	.....	2	1,003,000

Place	Population
[1]Alameda	35,140
[2]Albany	6,000
Alamo	100
Alleghany	300
Alta	100
Alvarado	1,120
Alviso	640
[6]Amador City	750
Anderson	1,180
Angel Island	500
Antioch	2,800
Applegate	100
[6]Aptos	200
Arbuckle	900
Artois	200
Asti	100
[2]Atherton	800
[6]Auburn	3,000
Bangor	50
Banta	50
[2]Barber	500
[2]Belmont	1,000
Belvedere	750
Benicia	2,750
[6]Ben Lomond	500
[2]Berkeley	80,000
Bethany	50
[6]Biggs	750
[6]Big Oak Flat	150
Bolinas	400
Boyes Springs	1,000
Brentwood	500
[2]Broderick	800
Browns Valley	125
[2]Burlingame	13,150
Butte City	200
Byron	400
Calistoga	1,000
[2]Campbell	1,500
Camp Meeker	300
Cana	500
[6]Capitola	450
[6]Carmel	2,500
Cement	1,000
Centerville	1,775
Cercs	1,100
[2]Chico	12,000
Chico Vecino	2,500
Cloverdale	1,000
[6]Colfax	800
College City	250
Collinsville	300
[2]Colma	2,900
[5,6]Columbia	400
[2]Colusa	2,200
Concord	4,200
Copperopolis	300
Cordelia	350
Corning	1,800
[2]Corte Madera	1,000
[2]Cotati	600
Cottonwood	704
Coyote	250
Crockett	2,500
Crows Landing	300
[2]Daly City	6,500
Danville	500
Davenport	500
[2]Davis	1,750
Dayton	60
Decoto	700
[6]Del Monte	300
Denair	400
[6]Dixon	1,200
Dobbins	100
Drytown	200
Duncan's Mills	250
Durham	600
[5,6]Dutch Flat	400
Dunnigan	150
Eldridge	500
[2,6]El Cerrito	3,000
Elmira	300
El Verano	500
[2]Emeryville	5,000
Empire	250
Escalon	700
Esparto	600
[2]Fairfax	1,200
Fairfield	1,200
Fair Oaks	500
Fall River Mills	316
Farmington	300
[6]Felton	300
Finley	100
Folsom City	1,500
Forest City	200
Forestville	300
[6]French Gulch	170
[1]Fresno	72,000
Gerber	400
Geyserville	750
[6]Gilroy	3,700
Glen Ellen	1,200
Gold Run	50
[8]Gonzales	500
Graton	250
[3,6]Grass Valley	6,000
[6]Gridley	2,500
Grimes	500
[6]Groveland	250
Guerneville	1,200
[6]Hamilton City	300
Hammonton	500
[2]Hayward	5,000
[6]Healdsburg	3,000
[6]Hercules	600
Hickman	40
[2]Hillsborough	1,000
[6]Hollister	4,500
Honcut	500
Hopland	500
Hughson	625
[8]Ione	900
Irvington	1,200
[6,8]Jackson	2,500
[5,6]Jamestown	1,000
Kelseyville	600
Kennett	492
[2]Kentfield	1,000
Kenwood	300
Keswick	20
[6]King City	1,600
Kingston	100
Knights Ferry	200
Knights Landing	525
La Fayette	300
[5]La Grange	200
Lakeport	1,250
[2]Larkspur	1,000
Lathrop	300
[2]Lawndale	60
Lewiston	100
[5,6]Lincoln	2,000
Live Oak	1,000
[6]Livermore	3,600
[1]Lodi	5,000
[2]Lomita Park	1,325
[6]Loomis	500
Los Altos	1,800
[2]Los Gatos	4,750
Los Molinos	460
Lylton	100
Madison	300
Magalia	100
Manteca	2,000
Manton	65
[2]Mare Island	600
[6]Martell	100
Martinez	7,000
[2]Marysville	8,500
Maxwell	600
McArthur	167
[2]Menlo Park	3,500
Meridian	250
[2]Millbrae	350
Mills	400
[2]Mill Valley	3,500
Millville	200
Milpitas	400
Mission San Jose	500
Modesto	17,000
Mokelumne Hill	237
[9]Monterey	6,900
Monte Rio	500
[6]Morgan Hill	1,200
[2]Mountain View	3,000
Mt. Eden	500
[2]Napa	7,000
Nelson	50
[2,8]Nevada City	1,800
Newark	1,100
[8]Newcastle	750
Newman	1,250
Niles	1,850
Nord	60
[2,6]Novato	1,000
[1]North Sacramento	2,500
Oakdale	2,000
[2,9]Oakland	295,000
Oakley	300
Occidental	600
Orland	2,100
[3]Oroville	7,000
Pacheco	300
[5]Pacific Grove	5,000
[2,6,7]Palo Alto	9,550
Paradise	600
Patterson	700
[2]Penn Grove	250
[6]Penryn	250
Perkins	350
[2]Petaluma	7,500
[2]Piedmont	9,000
[6]Pinole	1,000
Pittsburg	8,500
Pleasanton	1,800
Port Costa	990
Potter Valley	600
Princeton	300
[2]Red Bluff	3,500
[3,6]Redding	5,000
[2]Redwood City	8,000
[2,6]Richmond	28,700
Richvale	500
Rio Nido	250
Rio Vista	1,100
Ripon	1,000
Riverbank	1,200
[6]Rocklin	700
[6]Rodeo	900
[6,8]Roseville	7,000
[2]Ross	900
[4]Sacramento	105,000
Salida	300
[6]Salinas	6,500
San Andreas	600
[2]San Anselmo	4,500
[2]San Bruno	2,175
[1,2,6]San Francisco	708,000
[2]San Jose	68,000
[6]San Juan	500
[2]San Leandro	12,000
[2]San Lorenzo	1,000
[2]San Mateo	11,500
[2,6]San Pablo	1,500
[2]San Quentin	3,500
[2]San Rafael	7,800
[6,7]Santa Clara	6,500
[6]Santa Cruz	17,500
[2]Santa Rosa	14,000
Saratoga	1,300
[2]Sausalito	3,300
[2]Sebastopol	2,000
Shawmut	100
Shasta	46
Shellville	200
Sheridan	50
Smartsville	300
[6]Soledad	475
[6]Soquel	875
Sonoma	1,000
[5,6]Sonora	3,500
[6]Soulsbyville	200
[2]South San Francisco	6,500
Standard	800
[2,7]Stanford University	3,652
Stanislaus	100
[6,8]Stockton	55,000
Suisun	800
Sunol	500
[2]Sunnyvale	2,700
Sutter City	500
[8]Sutter Creek	1,000
Tehama City	200
[6,8]Thermalito	250
Thornton	135
Tiburon	500
[6]Towle	50
Tracy	4,500
[6]Tres Pinos	400
[6,8]Tuolumne	1,500
Turlock	5,000
Upper Lake	750
[6]Vacaville	1,300
Valley Home	200
[2,6]Vallejo	22,750
Vina	300
Vineburg	250
Walnut Creek	2,500
Warm Springs	300
Waterford	400
[6]Watsonville	7,300
[6]Weaverville	500
Wheatland	650
Williams	800
[3]Willows	3,000
Windsor	600
Winters	900
[2]Woodland	6,950
Woodside	300
Wyandotte	250
Yolo	400
[2]Yuba City	4,000
Zamora	100
Total Cities and Towns	1,983,104
Add Suburban Population	489,300
Total Population Served	2,472,404

Unmarked—Electricity only.
[1]—Gas only.
[2]—Gas and Electricity.
[3]—Gas, Electricity and Water.
[4]—Gas, Elect. and St. Railways.
[5]—Electricity and Water.
[6]—Electricity supplied through other companies.
[7]—Gas supplied through other companies.
[8]—Water supplied through other companies
[9]—Steam Heating.



Financial Independence—

rests upon the twin pillars of

Steady Saving *and* Intelligent Investment

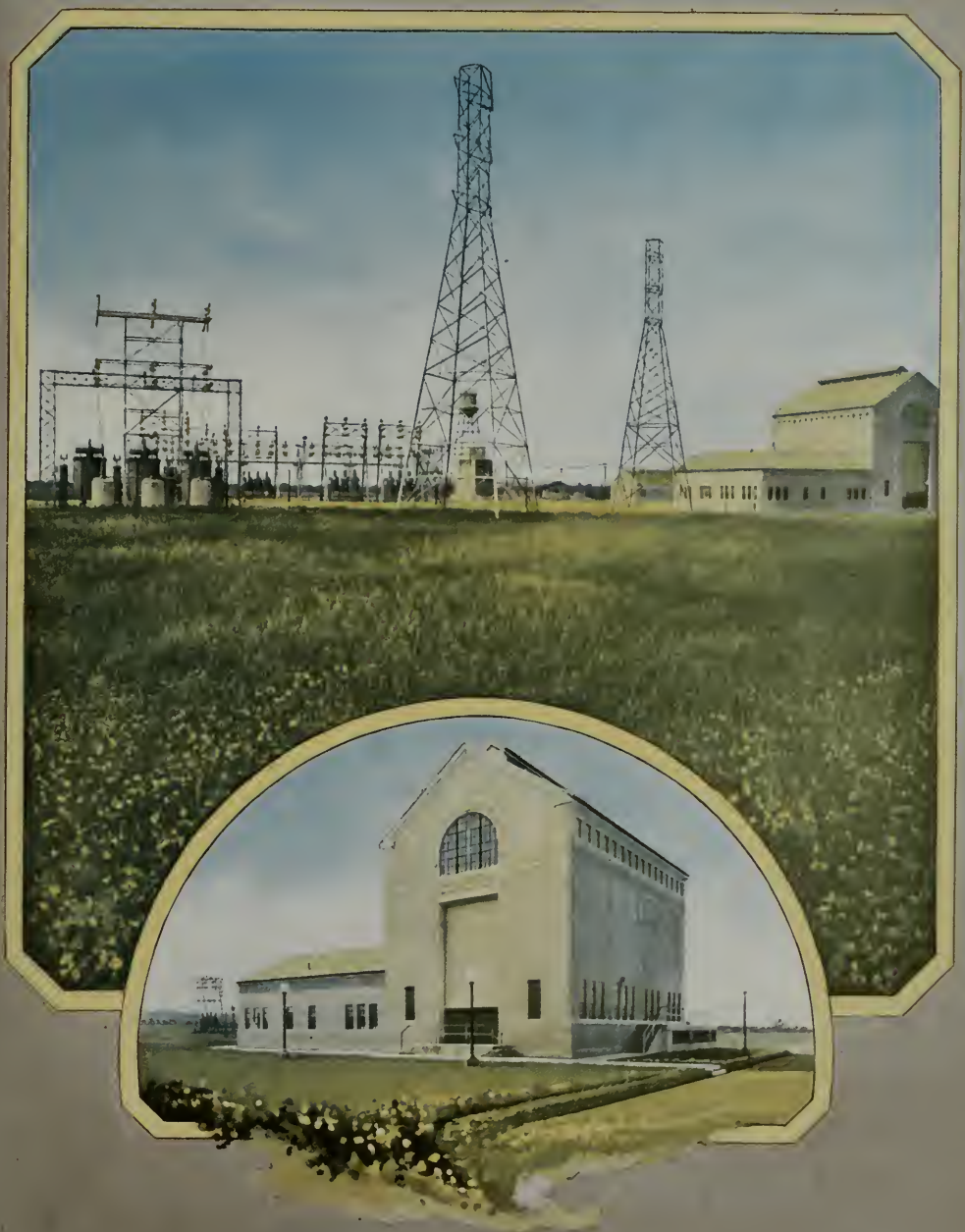
Pacific Gas and Electric Company First Preferred Cumulative 6% Stock is a thoroughly sound, seasoned investment. ¶ It may be purchased on the partial payment plan, thus affording an ideal means of steady saving. ¶ More than 24,000 discriminating investors, in every station of life, now own this stock. Thousands of them have thus invested their first savings. ¶ Why not lay the foundation of *your* financial independence *now?*

Write or telephone for circular descriptive of this investment

PACIFIC GAS AND ELECTRIC COMPANY
Stock Sales Department
245 Market Street · San Francisco

PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO



CONTRA COSTA SUB-STATION NEAR ANTIOCH
P. G. & E. HIGH TENSION ELECTRIC TRANSMISSION SYSTEM

Vol 16 — JANUARY 1927 — No 11

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER
FRANK B. ANDERSON
CHAS. L. BARRETT
W. E. CREED
W. H. CROCKER
A. B. C. DOHRMANN
JOHN S. DRUM
F. T. ELSEY
D. H. FOOTE
A. F. HOCKENBEAMER
FRANK A. LEACH, JR.
NORMAN B. LIVERMORE
JOHN A. McCANDLESS
JOHN D. McKEE
C. O. G. MILLER

OFFICERS

W. E. CREED . . . . . *President*
FRANK A. LEACH, JR. . . . . *First Vice-President and General Manager*
A. F. HOCKENBEAMER . . . . . *Second Vice-President and Treasurer*
D. H. FOOTE . . . . . *Third Vice-President and Secretary*
CHAS. L. BARRETT . . . . . *Assistant Secretary*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, JR., Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney . . . . . LAW DEPARTMENT
C. P. CUTTEN, Attorney . . . . . RATE DEPARTMENT
R. J. CANTRELL, Manager . . . . . PROPERTY AND TAX DEPARTMENT
E. W. HODGES, General Auditor . . . ACCOUNTING DEPARTMENT
H. T. TERRY . . . . . CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager . . . . . CREDIT AND STOCK SALES DEPARTMENTS
JOHN H. HUNT, Purchasing Agent . . PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent . . . SUPPLY DEPARTMENT
E. G. McCANN, Manager. . . . . PERSONNEL DEPARTMENT

ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT

O. W. PETERSON . . . . . Engineer of General Construction
E. H. STEELE . . . . . Engineer of Line Construction
F. R. GEORGE . . . . . Engineer of Operation
GEO. H. BRAGG . . . . . Engineer of Maintenance

DEPARTMENT OF ENGINEERING

J. P. JOLLYMAN . . . . . Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER . . . . . Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE . . . . . Chief of Division of Civil Engineering
F. M. HARRIS . . . . . Chief of Bureau of Specifications and Estimates
O. A. KNOPP . . . . . Chief of Bureau of Tests and Inspection

DEPARTMENT OF EXECUTIVE ENGINEER

F. C. PIATT . . . . . Valuation Engineer of Electric Properties
J. T. RYAN . . . . . Valuation Engineer of Gas, Water and Railway Properties
B. B. BECKETT . . . . . Rate Engineer
S. B. SHAW . . . . . Automotive Engineer
W. G. JACK . . . . . Manager Land Department

GAS CONSTRUCTION AND OPERATION DEPARTMENT

FRANK WILLS . . . . . Engineer of Production
R. S. FULLER . . . . . Engineer of Distribution
HARRY J. SMITH . . . . . Engineer of Construction

PUBLIC RELATIONS AND SALES DEPARTMENT

R. W. ROBINSON . . . . . Assistant to Vice-President in Charge of Public Relations and Sales
DON C. RAY . . . . . Manager Bureau of Public Relations
N. R. SUTHERLAND . . . . . Manager Commercial Department
H. M. CRAWFORD . . . . . General Sales Manager
R. T. STEPHENS . . . . . Manager Electric Sales
FORREST U. NAYLOR . . . . . Manager Gas Sales
J. CHARLES JORDAN . . . . . Manager Publicity Department

W. B. BOSLEY
General Counsel

JOHN P. COGHLAN
Assistant to the President

F. S. MYRTLE
Editor-in-Chief Pacific Service Magazine

DIVISIONS AND MANAGERS

DIVISION MANAGERS		DISTRICT MANAGERS		HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION			Marysville
		C. R. GILL	Colusa District	Colusa
I. B. ADAMS	DE SABLA DIVISION			Chico
H. M. COOPER	DRUM DIVISION			Auburn
		L. H. HARTSOCK	Nevada District	Nevada City
		J. V. KYLE	Placer County District	Auburn
L. H. NEWBERT	EAST BAY DIVISION			Oakland
		J. H. PAPE	Berkeley District	Berkeley
H. C. ROSS	FRESNO DIVISION			Fresno
H. G. RIDGWAY	NORTH BAY DIVISION			San Rafael
		L. J. PETERSON	Petaluma District	Petaluma
		C. D. CLARK	Napa District	Napa
		C. D. CLARK	Vallejo District	Vallejo
		M. G. HALL	Santa Rosa District	Santa Rosa
E. W. FLORENCE	SACRAMENTO DIVISION			Sacramento
		C. E. SEDGWICK	Solano District	Dixon
		J. W. COONS	Yolo District	Woodland
HENRY BOSTWICK	SAN FRANCISCO DIVISION			San Francisco
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION			Modesto
		W. E. ESKEW	Electra District	Jackson
		J. H. FAGG	Stockton District	Stockton
		CHAS. H. NOACK	Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION			San Jose
		W. T. KELLOGG	Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION			Redding
H. B. HERYFORD	WEST SIDE DIVISION			Red Bluff
		STEPHEN GOIN	Willows District	Willows
		CHAS. HUGHES	Red Bluff District	Red Bluff

Pacific Service Magazine

Volume XVI Number 11

Contents for January, 1927



DRUM POWER-HOUSE AS IT NOW LOOKS - - - *Frontispiece*

IN THE PUBLIC INTEREST - - - - - - *F. S. Myrtle*

Co-operation Between Power and Irrigation - - - - 343

Nevada County Irrigation Project Helped Out by Spaulding-Drum System - - - - - - - - - 345

"Pacific Service" Co-operates With South San Joaquin and Oakdale Districts in Project - - - - - - - 352

ELECTRICITY ON CALIFORNIA FARMS - - *W. E. Creed* 358

THE "PACIFIC SERVICE" ROLL OF HONOR - - - - - 362

GAS SERVICE IN THE RAILROAD SHOPS - - - - - 364

THE FINANCIAL SIDE OF "PACIFIC SERVICE" - *A. F. H.* 367

EDITORIAL - - - - - - - - - - - - - - 370



Drum Power-House, showing second penstock recently laid down the slope.

PACIFIC SERVICE MAGAZINE

Volume XVI JANUARY, 1927 Number 11

In the Public Interest--Co-operation Between Power and Irrigation

Two striking agreements by which "Pacific Service," while adding to its power generating and distributing resources, aids materially in the development of large agricultural areas.

By FREDERICK S. MYRTLE

"I regret the impossibility of being with you at the dedication of the Melones dam. I do, however, want to congratulate the interested parties upon the practical co-operative spirit which has enabled the public districts and the public utility to successfully work out by agreement a constructive and beneficial project, which, after all, is the only practical way in which so many of our California water problems can be accomplished. With personal regards.

"HERBERT HOOVER."

The quoted message from the Secretary of Commerce at Washington is from a telegraphic dispatch sent by him to California upon the occasion of the dedication of the Melones dam on the Stanislaus river, on November 11th last. It was addressed to the officials of the South San Joaquin and Oakdale Irrigation Districts in response to an invitation extended Mr. Hoover to attend the ceremonies held in celebration of the completion of their cherished water-storage project. The message is of value not only for the congratulatory terms in which it is couched but, also, for its evidence of a general realization on the part of the public-spirited men of the country that in co-operation among public service enterprises having a common interest lies not only successful prosecution of those enterprises but, also, substantial benefits to the people whom those enterprises are organized to serve.

This idea of co-operation has been gradually taking hold of the public mind until at the present day it is forming a watchword, a worthy legend to be inscribed upon the banner in the van of progress and development. It has been a slow process, perhaps. Public men and public ventures, that in their own interest as well as that of the common weal should have come together and made common cause, have been kept apart by various causes. One would have thought that self-interest, if nothing else, would have brought them together, but somehow or other the right step was not made, the right word failed to be spoken, and they went their different ways.

A striking instance of the need of co-operation was found in the general attitude of the farmer toward the power company. Surely they have a common purpose to serve which should take root to the elimination of desire for individual or group advantage. They have a common interest in adding to the greatness and prosperity of the state and of increasing the comfort and lessening the drudgery of all who make it their home. Growth of farming means growth of cities, more people to feed and an increased demand for electric energy. The power companies are seeking to promote the growth of the sections in which they operate. The farmer, on his part, is interested in the development of the soil, and he looks to the power company for the motive energy that will carry the much needed sustenance to his holdings in the arid months of the year. Electricity is today the leading factor of agricultural development, particularly in California. It increases production, while decreasing labor and operating cost. The California farm operator utilizes over four

times as much power on his farm as the average farmer in this country, and his net income is larger than that of the farmer in any other state and over twice the average for the United States. Why, then, in the name of common-sense should the farmer and the power company be as things apart?

Perhaps the first really practical step toward the realization of what was long regarded as a dream was taken when the power companies of California united their high-tension transmission systems in one great interconnection which now stretches from the Cascade mountains of Oregon to the Mexican border and from the Bay of San Francisco over the Sierras into the state of Nevada. That, of course, was co-operation in the highest sense of the term. By pouring the aggregate output of electric energy into a common pool, so that one section is in a position to relieve another in time of need, the power interests have made it possible for the tillers of the soil to have cheap and dependable power always at their command with which to work their farm motors and their various labor-saving devices. Secretary Herbert Hoover, who is quoted above, was heard upon this subject of interconnection at the great convention of the National Electric Light Association which was held in San Francisco during the month of June, 1925. He spoke with eloquence of the revolution taking place in the power industry as the result of the discovery of long distance transmission and consequent economies from the erection of large central generating plants and interconnection of distribution systems. He thought it was all for the common good, and he expressed little patience with the political agitator in his outcry against what every sensible business man must recognize as a practical business step in the direction of efficiency and economy.

But now co-operation has gone a step farther. The irrigationists and the power company have come together in their mutual interest, in the interest to serve. And, as in other features of the power industry that have gone before, our company may claim the glory of pioneership in this most recent departure from a long established order of things. Our company's president, Mr. Creed, in sitting down with the Board of Directors of the South San Joaquin and Oakdale Irrigation Districts two years ago, addressed them in these terms: "Our business is the power business; we have been thirty-five years in developing some of the best technical brains of this country. You want to build a dam on the Stanislaus river. We are warring over the waters of that river. You are going to take a long time to learn about the power business, and it would take us a long time to learn about the irrigation business. Why not make a treaty? Why not settle the war upon the Stanislaus? Why not work in harmony, you doing the irrigation business and we doing the power business?" The result was an agreement, the particulars and working out of which will be found in a following article.

A similar condition was found up in the High Sierras, where a once abandoned water storage project was revived in the interest of a large agricultural area in Nevada county, and its successful development made possible by our company's co-operation. A description of that enterprise also is given here. They were not the first. Some years ago our company entered into an agreement with the Thermalito Irrigation District, in the vicinity of Oroville, by which we agreed to pay the district for the use of its water for power purposes.

No one is injured in such an agreement; everybody is benefited. The water is neither grabbed nor absorbed. It is merely used to turn the wheels of power-houses, and then restored to the irrigation flumes and canals. It is all as simple as a.b.c. and quite as straightforward. Other utilities have followed suit; other irrigation districts with different problems have worked out plans of co-operation with power companies. A notable instance is the agreement between the Merced District and the San Joaquin Light and Power Corporation. There will be more and more of these as time rolls on.

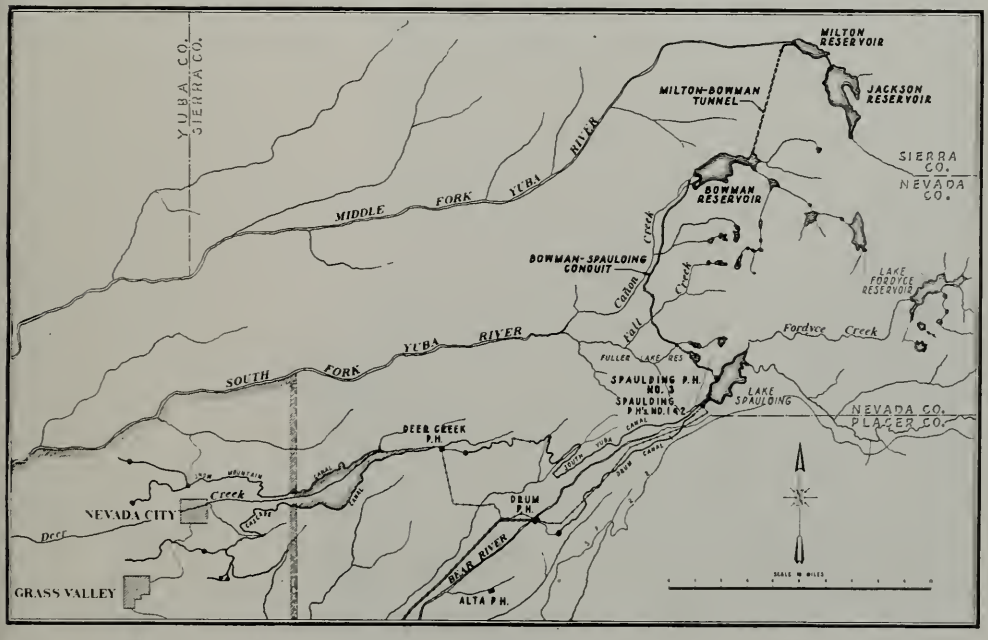
Nevada County Irrigation Project Helped Out By Our Spaulding-Drum System

The first and more striking of the two co-operative plans is based upon an agreement between the Nevada Irrigation District and the Pacific Gas and Electric Company executed in May, 1924.

By the terms of this the irrigation district agrees to deliver to our company a stipulated quantity of water from its storage system in the High Sierra country to be used for power development purposes. For the use of this water our company will pay an amount sufficient to cover interest and redemption charges upon the bond issue through which the irrigation district obtained funds necessary for its construction work.

The Nevada Irrigation District was organized August 4, 1921. It comprises 209,610 gross acres of land situated in Nevada County, California. The towns of Grass Valley and Nevada City are in the territorial limits of the district, but are excluded from its operation and obligations. It is foothill country, lying between an elevation of 400 feet on the west and 3500 feet on the east, and has been noted as a center of extensive mining operations. Agriculture has been successfully practiced here, and in type of soil and general conditions the territory resembles the adjoining Placer county section, where extensive cultivation of high-grade fruits has been in practice for many years. Of the district's gross area, irrigation by gravity is practicable on 126,307 acres, and it is reported that 32,038 acres are now cleared and ready for irrigation.

The district's projected source of water supply is found in a storage system part developed and part in process of development on the middle and south forks of the Yuba River, north of our company's Lake Spaulding and lying at elevations ranging from 5000 to 8000 feet above sea level. Two reservoirs of sizeable capacity yet to be



Map of the Nevada Irrigation District project and its connection with our company's Spaulding-Drum system.

constructed are Milton and Jackson reservoirs, both on the middle fork of the Yuba, and over the border line of Sierra County; but the central and most important of the system is Bowman, situated on Canyon Creek, a tributary of the South Yuba. Bowman is the chief of a small cluster of reservoirs lying under a ridge separating the Middle Yuba watershed from that of the South Yuba. On the South Yuba side lie Meadow Lake, Lake Fordyce and Lake Spaulding, all of our company's Spaulding-Drum system. Meadow Lake is the site of a once prosperous mining community which flourished in the early sixties, and at this day when the lake is dry one may see scattered around in profusion old pans, bottles, even stoves, that lie there just as they were abandoned by the miners in their hasty flight for other parts when the mining bubble burst.

As a matter of fact, Bowman reservoir itself was built more than a half a century ago and was long used as a source of water supply for the North Bloomfield hydraulic mines. It has two dams, at separate openings, and the work now consists in replacing these old timber-crib relics of the '70s with modern structures. The main dam now in process of construction is to be of rock-fill type, 167 feet in height and 680 feet along the crest, while the second dam, which will be used as a spillway, will be a concrete structure 117 feet in height and 430 feet in crest length. This work will result in the development of a storage reservoir of 65,000 acre feet estimated capacity.

There is in process of construction a conduit consisting mainly of a four-mile tunnel by which water from the new Milton and Jackson reservoirs will be conveyed southward to swell the storage at Bowman. Then, from the southern extremity of that reservoir connection with our company's Spaulding-Drum system will be made by means of a water conduit including three one-half-mile tunnels and nine miles of canal by which the water from Bowman will be carried to the upper end of Lake Spaulding, where it will be used, first, to turn the wheels of a new power-house to be constructed on the rim of the lake and to be known as Spaulding No. 3. The power generating equipment here will be of 9,300 horsepower capacity. Pass-



Bowman dam in course of construction. Intake of outlet tunnel.



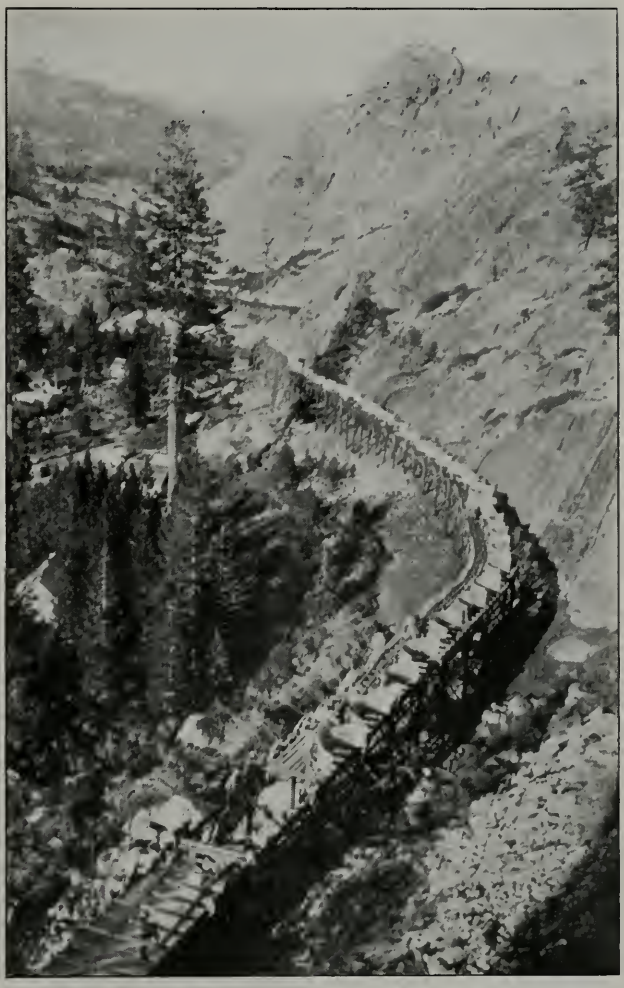
Bowman dam. Downstream face, showing outlet discharging.

ing through Lake Spaulding the greater part of this additional water supply will be taken by way of Spaulding tunnel and Drum canal to Drum power-house, where after utilization for power generating purposes it will flow into Bear River and on down valley to a point near Colfax, where by means of a diversion dam it will be returned to the irrigation district The smaller part will be diverted at Spaulding No. 2 development into the old South Yuba flume by which it will be carried across country to our company's Deer Creek power-house. After utilization for power purposes the water will be turned into the Deer Creek distributing system for conveyance to the irrigation district territory. In this latter connection it is worthy of note that only recently our company disposed of its Deer Creek distributing system to the Nevada Irrigation District. The system includes two canals of historical interest, one the Snow Mountain, which supplies Nevada City with water, and the other the Cascade, which supplies Grass Valley and the surrounding territory which takes in a group of rich gold mines, among them the famous Empire and North Star.

The Nevada Irrigation District is under obligation to deliver to our company 108,000 acre-feet of water from July 1st to March 31st of each year, from which the minimum annual revenue from power to the district will be $370,500. The district has incurred financial obligations to the extent of $6,000,000 par value 5½ per cent bonds. The whole project has received the official approval of the Federal Power Commission.

In order to take full advantage of the additional water supply that will be provided by the Nevada Irrigation District storage system and, also, that which will result from the raising of the dam at Lake Fordyce, reference to which has been made in previous issues of PACIFIC SERVICE MAGAZINE, considerable reconstruction work is in progress from end to end of our company's Spaulding - Drum electric generating and distributing system.

At Lake Spaulding the existing power-house in the tunnel adit below the dam and known as Spaulding No. 1 will be dismantled during the present winter to make way for a plant of larger capacity. The new equipment will be of 10,700 horsepower capacity. Then, the old equipment of 5000 horsepower capacity will be transferred to Spaulding No. 2 plant, in the bed of the south fork of the Yuba River just below Spaulding No. 1, and through which water passes from Spaulding tunnel and on to Deer Creek by way of the old South Yuba ditch system. Adding to these figures the



Bowman-Spaulding conduit. Metal flume under construction.

projected equipment at Spaulding No. 3, which as before stated, will be of 9,300 horsepower capacity, we find electric power development at the very storage point of an aggregate installed generating capacity of, in round numbers, 25,000 horsepower.



Resident operators are well housed at Spaulding.

Next, Drum canal is being enlarged from a capacity of 350 to one of 500 cubic feet per second to accommodate the additional flow, and not only will the canal be enlarged but, also, the present timber flumes which have been in service for about thirteen years will be replaced by permanent structures of concrete and steel. Arriving at Drum forebay, the improvement work here consists of a second penstock laid from the forebay to Drum power-house. The lower portion of this penstock, reaching from the top of the slope to the power-house, is already in place. This new penstock differs in construction from the other in that it is built off the ground on concrete piers, a similar character of construction to that at Pit No. One development. It is of riveted steel and varies in diameter from 72 inches at the upper end to 54 inches at the power-house. Before laying it in its place the pipe was thoroughly sand-blasted to remove rust and scale, after which it was given three coats of paint; a thorough job in every respect.

At Drum the generating equipment will be increased by the installation of a fourth generator, bringing the total generating capacity up to 66,666 horsepower. On account of the high head available at Drum and its large forebay it has become a very important governing plant of the system. The power-house equipment is furnished with an automatically regulated governor so that the plant meets the demand for additional load from time to time. As a result, however, there has been an irregularity of stream-flow in Bear River canal, which conveys the water from the Spaulding-Drum system upon its errand of usefulness to operate Halsey and Wise power plants lower down the valley and, also, to help provide sustenance for 37,000 acres of deciduous fruit lands in the territory around Auburn and Newcastle. Our engineers, therefore, decided to take measures to correct any irregularity and provide Bear River canal with a uniform flow equal to its capacity by constructing an afterbay in the stream at a point half a mile below Drum power-house.



Lake Spaulding in winter. The 275-foot dam at left of picture.

At this point a concrete dam was constructed 100 feet in height and of 175 feet radius through which the waters of Bear River are backed up to the tail-race of the power-house. The capacity of this afterbay is 370 acre-feet, enough storage to furnish full flow through the canal during such parts of the day as Drum power-house may not be operating to capacity. It is estimated that the additional storage at Fordyce will enable Drum canal to flow to capacity during the greater part of the year, and there is no reason why Bear River canal below should not receive the full benefit of that flow. Thirty feet below the crest of this afterbay dam are two 54-inch outlet pipes to which are attached needle valves, their purpose being to automatically regulate the outflow to a uniform stream. In addition, there is an open spillway section furnished with five openings each of 13 ft. width and 6 ft. depth to discharge the flood flow over and above the amount that can be carried through the regular discharge pipes. In this way the stored water is permitted to flow down Bear River in a stream of uniform volume so that it can be diverted without waste into the head of Bear River canal, whose intake, as most of our readers are aware, is situated at a point about one mile above Colfax underneath the trestle bridge of the narrow gauge railway running between Colfax and Grass Valley. Bear River canal, which takes the water from this point down valley, will be enlarged to accommodate the augmented supply. Halsey and Wise developments, the former situated near Clipper Gap, seven miles above the town of Auburn, the latter in the ravine between Auburn and Newcastle, each of 16,750 horsepower installed capacity, will also benefit from the increase of water flow.



A section of canal near Auburn, showing metal flume.



Spaulding No. 1 power-plant below the dam.

The whole thing is really a scheme of practical water conservation. In addition to providing our company's electric users in the Drum-Spaulding region with many millions of additional kilowatt hours it will permit the irrigation of an additional 10,000 acres of deciduous fruit lands, bringing the acreage benefited by our company's water storage in the Sierra Nevada section from 27,000 to 37,000. The importance of this reconstruction work cannot be overestimated. It looks not merely to the present but to the future.

An additional feature of the work has been the building of a road into Drum from Alta, a distance of about seven miles, along the grade of the old Miners' Ditch which was built in early days to convey water for mining purposes from Bear Val-

ley into the camps of Dutch Flat and Gold Run; a relic, therefore, of the old hydraulic mining days. Primarily, the construction of this road was to provide a permanent way for operators and visitors and so avoid the long detour by Drum forebay from which point the only access to Drum power-house was by means of a tramway down the 1375-foot slope. A trip along this new road is worth while. It is picturesque to a degree. The road rises from the level of Bear River at Drum to an altitude of 1500 feet above the stream bed. It is a road of many turns and no bridges. It has no timber construction; it has been made by widening the way of the old Miners' Ditch and there is an interesting point on the road where the course of the ditch and the new road diverge. Traveling Altaward one may see numerous points of interest to those who treasure memories of early days. One may look down upon the Liberty Hill mine and Bill McQuire's reservoir built to catch the tailings therefrom. The Drum line right-of-way may be seen traveling over the hills to the right, and yet farther on the Alta-Sacramento transmission line. Approaching Alta there stands out to the view another historical eminence, Elmore Hill, near the little Bear River, once the center of wondrous activities in the hydraulic mining days. Then, when you get almost to the end of the journey, instead of running into Alta you may keep straight on and pass down through Dutch Flat, one of the oldest as well as quaintest old-world communities that you will find in the Sierra Nevada region.

What has been said before about Meadow Lake applies here. You will come across things just as they were in the days before the inhibition against hydraulic mining turned a once busy, thriving community into an almost desolate, sleepy village of dreams. Running into Dutch Flat your car passes over two penstocks leading from Boardman canal to the once famous Polar Star mine. The two penstocks side by side are laid across the road at the upper edge of the town. Behind the town itself, less than a quarter of a mile away, lie the old diggings just as they were when the miners decamped in the '90s. There are monitors lying on the ground where they have lain all these years, and an interesting reminiscence of those times is found in the still standing tunnels through which tailings were carried to the river. In the town itself there are men living who remember those days.

Work on the combined power and irrigation project is progressing rapidly, and part of the water will be ready for delivery in time for the irrigation season this year. The entire completed project is expected to be in full operation by 1928.





Afterbay dam, Drum power development.



View of the abandoned diggings at Dutch Flat.

The history of irrigation in Placer county dates back to the year 1858, when a Mr. Crow, on what is now known as the Threlkell ranch, planted ten acres in grapes and peaches and irrigated his holding from a nearby mining ditch. About two years later Dr. Miller planted about twenty acres with fruit trees shipped from Switzerland to this country around the Horn. His farm was on the American river and was irrigated from the North Fork ditch, a very important mining ditch at that time. It is now known as the Robert Hector ranch.

From these and other early experiments it was seen that fruit-growing could be very successfully carried on in Placer county if an adequate supply of water for irrigation could be had. Owing to the scarcity of the supply, however, very little progress was made until, in 1879, the South Yuba Water Company came to the rescue. This company had a number of storage lakes and an ample supply throughout the year for the greater portion of which they had no sale, due to the closing down of the hydraulic mines in Nevada county. From that time on the fruit industry in Placer county made rapid progress.



Views on the Drum-Alta highway.

The purchase of the South Yuba Company's properties by our company in 1905



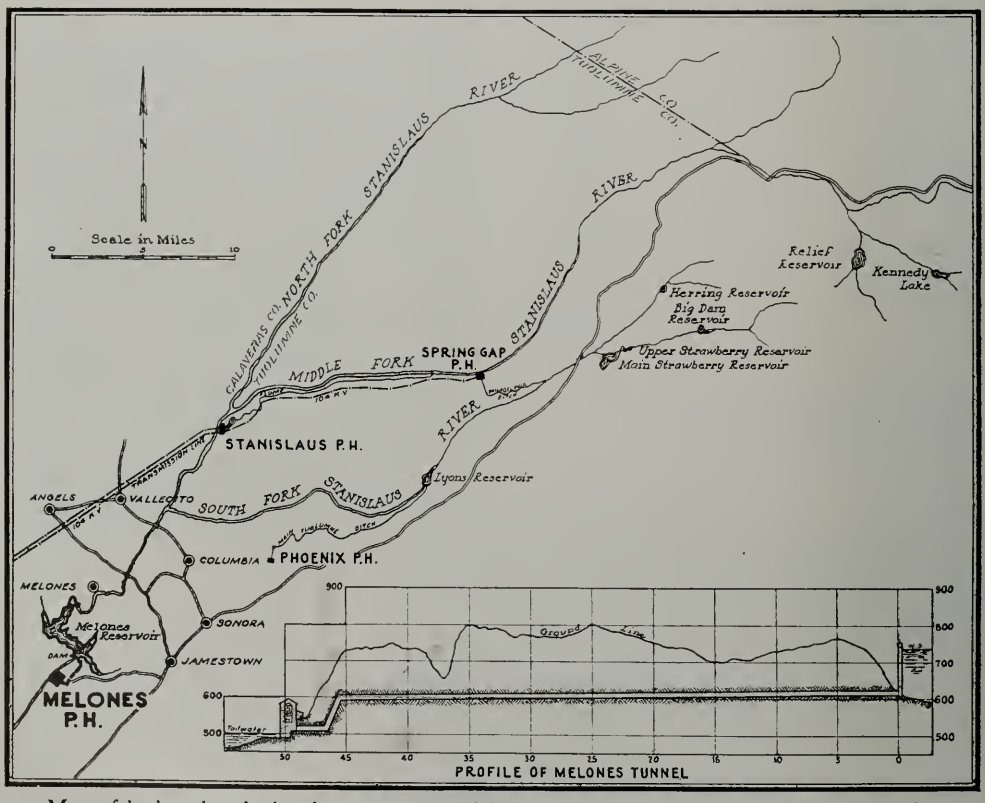
formed the nucleus of what is now known as the Spaulding-Drum system of "Pacific Service." The great dam at Lake Spaulding was placed in service in November, 1913, and, at the same time, Drum power-house with its initial installation of 33,333 horsepower. Halsey and Wise plants came next in order of construction.

"Pacific Service" Co-operates with South San Joaquin and Oakdale Irrigation Districts in Project

The second project and one which is important in point of extent and character of area to be benefited concerns an agreement between the South San Joaquin and Oakdale Irrigation Districts, on the one side, and the Sierra and San Francisco Power Company and Pacific Gas and Electric Company, the latter operating the properties of the former under a lease, on the other. This involves the construction by the irrigation districts of a dam on the Stanislaus river, near the town of Melones, so creating a storage reservoir of 112,500 acre-feet estimated capacity, and the construction by the companies of a water-power plant of 40,000 horsepower capacity to be operated by water from the dam, the power companies agreeing to pay the irrigation districts for the use of the water a sum of money sufficient to cover interest and redemption charges upon the bonds issued by the districts to pay for their storage project.

In a word, the agreement is almost identical in character to that between our company and the Nevada Irrigation District. It is a co-operative project and one that will not only be for the material benefit of all parties concerned but, also, will have the effect of settling all disputes concerning water rights on the Stanislaus river.

The Oakdale and South San Joaquin Irrigation Districts were organized in the year 1910, under the Wright Act, the districts acquiring water rights on the Stanis-



Map of hydro-electric development operated by our company on the Stanislaus river, with location of the Melones combined irrigation and power project.

laus river by purchase of the old Tulloch system. The first construction work effected was the Goodwin dam, on the Stanislaus river, eighteen miles up stream from Oakdale, and in 1913 water was first delivered by the irrigation districts from the river. The districts grew as the years rolled by, but as the population increased and more lands were irrigated and a greater variety of crops raised it became evident that the natural flow of the Stanislaus was not sufficient to give full service during the five irrigating months of the year. The irrigation enterprises, in a word, suffered from lack of sufficient water storage for the expansion of agricultural development. The territory embraced by the two districts is a fruitful one, involving large tracts in the counties of Stanislaus and San Joaquin and lying between the cities of Stockton and Modesto. The gross irrigable area is given as 145,258 acres and the area under irrigation 77,559 acres. In an effort to remove the handicap under which they suffered and provide water for late summer and fall irrigation the officials of the two districts proceeded to extensive investigations of reservoir sites. These investigations were conducted over a period of years, and selection was finally made of a site at the head of Iron Canyon, a short distance from the old



Melones reservoir as it looked December 18th, 1926.



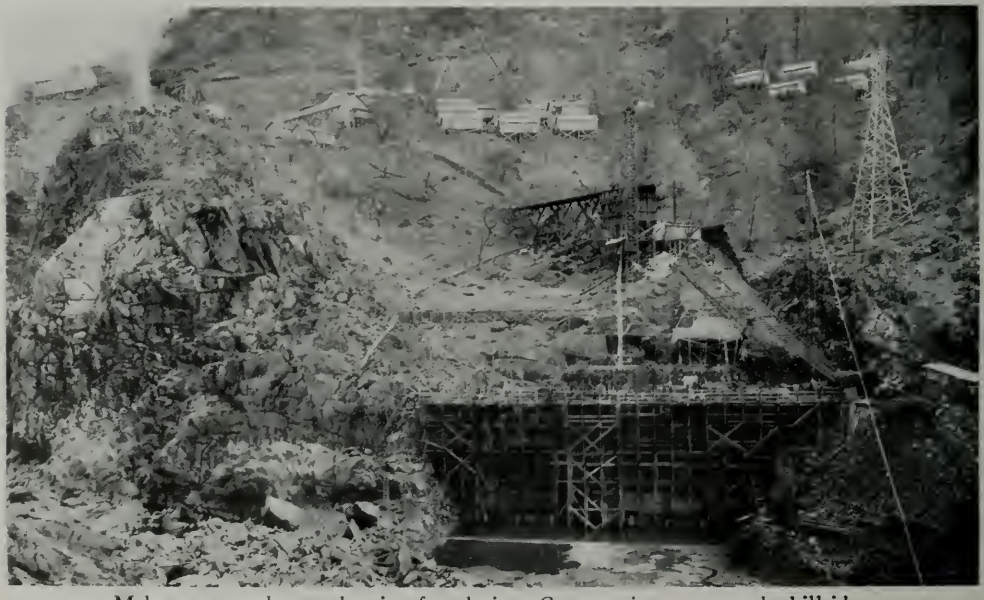
Melones dam and reservoir. Picture taken November 20, 1926.

town of Melones, where the Stanislaus forms a natural gorge which offered unusually good storage possibilities.



Site of Melones power-house in a gorge of the Stanislaus river.

But it was not until the officials of the power companies sat down with the directors of the irrigation districts that real headway was made. Negotiations, of course, looked toward the sale of water by the irrigation districts to the power companies for power purposes only. These finally resulted in a joint agreement between the four parties at interest formally executed January 15, 1925, whereby the combined project was to be built. The power companies, on their side, agreed to erect a power plant, to be called the Melones plant, to cost $2,500,000 and to be capable of generating 40,000 horsepower of electric energy, at a point about a mile down stream from the dam and to be operated by water diverted thereat. They agreed to pay the districts for the use of the water to operate this a total sum of $5,175,000, payments to be spread over a period of forty years. The output from the power plant to be poured into the "Pacific Service" electric distributing system, to the manifest benefit of electric users in the surrounding territory, particularly the irrigation area controlled by the districts. It was agreed that the districts should control the river flow from March 1st to November 1st, the power companies the remainder



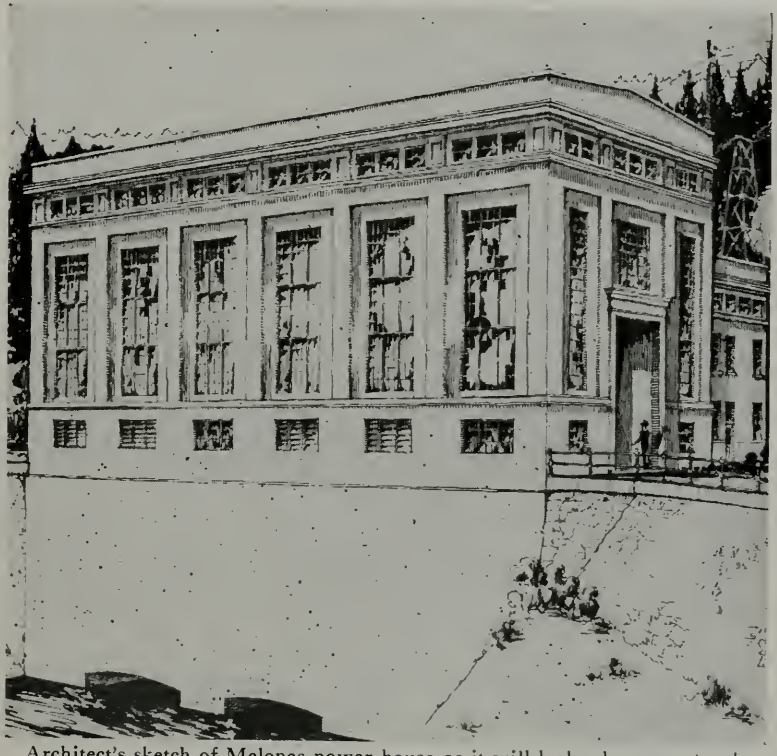
Melones power-house, showing foundation. Construction camp on the hillside.

of the year. After the water used by the companies has served the purpose of power generation it is to be returned to the Stanislaus river, down which it will flow some eight miles to Goodwin dam, at which point it will be diverted into the districts' canals for distribution to irrigation users below. At the conclusion of the period of forty years, when the stipulated payments will have been completed, the power companies will enjoy perpetual use of the water from the dam for power generation, the sole charge upon them being that of sharing equally with the irrigation districts the costs of maintenance.

Not only do the irrigation districts benefit materially through this co-operative agreement with the power companies, but they also may benefit directly by contributions of additional stored water which comes down to them from the Sierra and San Francisco Power Company's reservoirs at Strawberry and Relief, in the Sierra Nevada mountains east of Sonora. As a matter of fact, the power companies have already put the co-operative idea into practice, for during the last year the stream-flow in the Stanislaus river dropped extremely low, and in order to make up the deficiency in supply of water for irrigation purposes "Pacific Service" drew heavily from Strawberry and Relief reservoirs during the season, so at the close thereof they were completely emptied. Furthermore, the water was turned over to the districts without charge.

Relief reservoir is the farthest east of the two. It is near the border line between Tuolumne and Alpine counties at an elevation of 7,200 feet above sea level, the Sonora pass road over the mountains passes close by. It connects with the middle fork of the Stanislaus. Strawberry reservoir, at an elevation of 5,500 feet, is on the south fork of the Stanislaus, and thence the water is carried into the middle fork by the Philadelphia ditch, serving to operate, first, Spring Gap power-house and, lower down, Stanislaus power-house, controlling plant of the San Francisco and San Joaquin system.

The contract between the irrigation and power interests was submitted to the people of the districts concerned for their ratification. This they effected on May 18th, 1925, by carrying a special bond election at which the sum of $2,200,000 was voted for the water storage development work. Construction was started without delay and was prosecuted with such celerity that the Melones dam was completed in the fall of 1926. It is of constant radius, concrete arch type. In height it is 210 feet above bedrock and 585 feet along the crest. It backs the waters of the Stanislaus over twelve miles up stream. It is the highest



Architect's sketch of Melones power-house as it will look when completed.

over-pour dam in the world. The dedication ceremonies were conducted on Armistice Day, November the 11th last, in presence of officials of the various corporate interests concerned. In the crowd that assembled were representative men and women from all parts of central California, including a delegation of Stockton Chamber of Commerce members. An invitation was sent to Secretary Herbert Hoover of the Department of Commerce in Washington, and while he was unable to comply he sent a telegram of congratulation which appears elsewhere in this issue.

At the time of writing Melones reservoir is full, the waters reaching to the crest of the dam.

Meanwhile our company's engineers lost no time in starting work on the "Pacific Service" end of the project. The districts' construction work stopped at the irrigation outlet 400 feet below the dam, at which point the power development project has its beginning in the form of a concrete lined pressure tunnel 4,400 feet in length of horseshoe shape, 12 feet in diameter and of 1,500 cubic feet per second water carrying capacity. The work of boring this tunnel was naturally a long job, but it is now completed and the tunnel is being lined with concrete. From the downstream end of the tunnel two short pressure tunnels eight and one-half feet in diameter take the place of penstocks to carry water to the turbines in the power-house on the river bank. The



Installing machinery in December, 1926.

foundation for the power-house has long since been completed and now the steel frame is in place and concrete is being poured. Work of installing the electric generating equipment is in process. This consists of two turbines of a total installed capacity of 34,000 horsepower, to which are directly connected two vertical shaft generators of 27,000 k. v. a. total capacity. By means of a bank of transformers the current generated in this power-house will be stepped up from a generating voltage of 11,000 to one of 115,000 volts for transmission a distance of 7½ miles to Copperopolis, the nearest point on the Sierra and



Section of the 4400-foot tunnel leading from dam to power-house.

San Francisco Power Company's system where the transmitted electric energy may be poured into the "Pacific Service" power pool.

The estimated output of electric energy from the Melones plant is placed at 100,000,000 kilowatt hours per annum, sufficient to meet the requirements of a community of the size of Sacramento. It is expected the entire plant will be in full operation by June 1, of this year.

The entire project has received enthusiastic endorsement from the people of the San Joaquin valley from Stockton south. The State Bonding Commission, in granting permission to the irrigation districts to call the bond election, was out-spoken in its hearty approval. "The best proposition ever submitted to the people of California," was the opinion given by the state body, and State Engineer McClure voiced the opinion that the Oakdale Irrigation District has the brightest future of any irrigation district in the State.

The public press generally is loud in its praise of the enterprise. The *San Francisco Chronicle* calls it "an important object lesson." An instance of local expression is found in an editorial in the *Stockton Record,* April 24, 1925, which said:



President Creed of our company (center) in company with D. O. Castle, President of South San Joaquin, and H. S. Crowe, President of Oakdale Irrigation District, at the Melones dam dedication ceremonies. (It was a wet day).



Stanislaus power-house, controlling plant of the Sierra and San Francisco Company's system.

"There should not be the least bit of opposition to the bond issue. The farmers of South San Joaquin will secure their badly needed storage free of cost. The only liability incurred will be as guarantors of the bond payment; and in the case of the P. G. & E. this amounts to practically no liability at all, for the big corporation can be depended upon to meet the obligations."

Electricity on California Farms

By WIGGINTON E. CREED

A Radio Address Over KGO, Thursday Evening, October 21, 1926

This evening has been set aside by the great broadcasting stations of the country for a review of the problems and achievements of the electrical industry. As California was the first state in the Union to make practical application of electric power to the tasks of agriculture and now leads all the states in the use of electricity on the farm, it has seemed to me quite appropriate that I should tell Californians tonight something about "Electricity in Agriculture."

The first electrical power installation for farm purposes in California was made in the year 1900. The place was a farm near Marysville, Yuba County; the work, the pumping of water for irrigation. One of the founders of the Pacific Gas and Electric Company, John Martin, set up the motor and pump, dreaming of the day when a network of electric lines would cover rural California. Mr. Martin, like most men with dreams, was ahead of his time, a pioneer. Power men of that day were not with him. They thought the great cost of delivering electric energy to isolated farms would be prohibitive; moreover, their eyes were on the business of cities, where consumers were closely congregated. Even farmers themselves thought electric power was too new and too uncertain to be relied upon to drive pumps or even to furnish light. It took considerable salesmanship to install the first motor. The Company had to extend its line to the farmer's house at its own expense. It had to lend the farmer the motor with the understanding that he would pay for it only if it proved satisfactory. The first motor did prove satisfactory, and soon a second and a third were installed in the immediate neighborhood. So satisfactory were the installations that the farmers invited all their neighbors in to see them. It is reported that some, more enthusiastic than others, drove about the country side, picking up strangers and taking them to their farms to witness the marvel of the electric pump and the wonder of the barns and outhouses, lighted by electricity.

From the motor and pump of that early day, California has progressed to the point where nearly half the power used on her farms is electric power; where her farms use three times as much electricity per acre as the rest of the United States and where more farm homes are served with electricity than in any other state in the Union.

Students of the relation of electricity to agriculture speak of California as their "graduate laboratory." They use this expression because California has passed through all the grades of electric farm service as we know it today, and has laid down a well defined course for others to follow.

California has not been satisfied with a conventional use of electricity on the farm. It has not stopped with pumping and lighting and heating or with small appliances or motors in farm houses or barn, but has reached out for new uses in new fields.

For example, there is an electric chicken hatchery in Petaluma, that has 3,780 electric incubators in continuous operation, night and day, during the hatching season. These incubators take 1,800,000 eggs at a setting and hatch out 70,000 chickens every day. Naturally the fame of Petaluma has travelled around the world and it is now making incubators for foreign markets.

I am reminded of an incident that occurred at the World Power Conference in London in 1924. With representatives of about all the countries of the world present, a day was given to telling of accomplishments in the industry. A representative from Norway told of what his country had done; another spoke for Japan, another for the United States, and so on. Then a representative from England stepped forth and proceeded to outline the extraordinary way in which electricity was being used in the vicinity of London for hatching chickens. He made the achievement so interesting that some of the American representatives went out the next day to see the installation. And this is what they found: an electric hatchery with electric incubators

bearing the legend: "Made in Petaluma, California, U. S. A."

In justice to other states it must be said that California's wide-spread use of electricity on the farm is not due solely to her progress and her desire for experiment and investigation. Conditions here are favorable for rural electrification. The water power of the state is in the high mountains on its eastern rim. The first markets for power were in the cities on the coast or in the valleys lying between the mountains and the coast. Of necessity, transmission lines had to cross and re-cross these valleys, thereby making the energy they carried accessible to the farms along the way.

As California is an irrigated state, there was soon a considerable demand for power for pumping water either from wells or from irrigation canals. Electric pumps soon proved to be efficient and popular, and today they dot the land. As the reverse of pumping water upon land, we have in California, large tracts of reclaimed land along river bottoms which must be kept free of water in winter. Water must be pumped off, not on them. Electric pumps do this service too, and there are reclaimed farms in California which boast that their pumps are the largest of their kind in the world.

The year that is now drawing to a close has seen great activity in the extension of rural lines not only in California but all over the United States. More farms probably have been brought under electric service than in any previous year. Moreover, the country has witnessed the most intensive study and investigation of electric service on the farm that it has yet known. In 20 of the 48 states, state committees on the relation of electricity to agriculture have been studying and investigating local conditions and making experimental installations. Recommendations of the greatest practical benefit have gone forth both to the rural consumer and the electric generating companies.

These committees have not confined their activities to any one section of the country, but have operated from New Hampshire to California and from New York to Alabama. In some states, like Minnesota and Wisconsin, large areas have been covered with experimental lines and careful tests have been made as to the character of the service required, the cost of such service and the advantages to be gained by its use.

This whole work has been under the general supervision of a national committee organized a few years ago by the National Electric Light Association in co-operation with the American Farm Bureau Federation and the United States Department of Agriculture. Working together in this voluntary association for the common good are the leading farm organizations of the country, the General Federation of Women's Clubs, the American Society of Agricultural Engineers, various other national, social and economic organizations, and three great Federal agencies—the Department of Agriculture, the Department of Commerce, and the Department of the Interior. State committees have been generally under the direction of agricultural colleges, and here in California the work is in the keeping of the College of Agriculture of the State University.

It is at present estimated that the transmission and distribution lines now in operation bring electrical service within reasonable distance of 1,500,000 farms in the United States. This is slightly less than one-fourth of the total farms of the country. The problem is to get electric service from these lines into all these 1,500,000 farms. The fact that a distribution line runs past a farm does not mean electrical service for that farm. To obtain service the farmer is required to provide means for making use of electricity. He must wire his house and farm buildings and he must purchase electrical equipment. Until he does this preliminary work, he cannot make use of electricity no matter how near it is to him.

According to a reliable estimate, only 8 per cent of the farms of the country have electrical service of any kind. Those which do not have service include the thousands of small farms that cannot afford the installation cost of such service; they also include those too far distant from transmission lines or from generating centers to receive electric power; they include, too, those which for special reasons having to do with location, can use animal power or some other form of mechanical power to better advantage than they could use electricity. Many of these farms in the very nature of things cannot in our time at least be given

electrical service. However, 47 per cent of the farms of the United States have some kind of stationary power already installed. Many of these can and will eventually substitute electricity.

Wherever power has been used on the American farm the average agricultural worker has been able to increase his volume of production. It is reported by the United States Department of Agriculture that mechanical power has increased the production of the American farmer nearly three times in the last 75 years.

"Power and labor together," says the Department of Agriculture, "represent on the average about 80 per cent of the total cost of carrying on the farm business and since these are two items directly subject to the control of the farm operator, great opportunities exist for the cutting down of production costs through a better understanding of power requirements, through the adoption of more efficient and less expensive types of power units and by more extensive use of power to replace farm labor."

Wherever electric power has been applied on the farm in this country, there living conditions have been improved and there production per worker has been increased. There also has there been a reduction in farm operating costs and improved quality in products produced.

On the part of the power companies no one thing has done as much to bring electricity to the farm as the interconnection of transmission lines and generating stations. It is the interconnected systems of today that put electricity within reach of the farm, and it is the interconnected system which is the very foundation of California's rural service.

In the early days of the electrical industry the power generating station was a local institution, serving a single city or town with a self-contained distribution system. Its service did not reach outside of its municipal boundaries and it assumed no obligation beyond its own territorial limits.

The development of large companies and the interconnection of transmission lines has changed all this. Power companies no longer find it economical to have separate generating stations in each city or town. Rather they find it essential to connect dozens and even scores of cities and towns together and to spread their network of distribution lines over wide areas. Electric service through this development has ceased to be a local affair and has become a regional service. It is no longer confined to single cities or towns with local favors and local rates, but is spread out over a wide area, covering both the thickly settled city and the scattered back country.

California today is divided into three major areas in which rates are fixed for each area, not on the basis of cities standing separate and alone, or on the basis of farming communities standing by themselves, but as areas made up of urban and rural communities, tied together as one.

What is true of California is true all over the United States. Rates are now being made for entire state areas based on regional requirements, and not on the advantages of any city or town or any group of cities or towns.

The only exceptions are where cities have municipal ownership of their electric light and power service. There the cities stand alone and apart from the whole rural and agricultural area which surrounds them.

In California approximately one-third of the population is directly employed in agricultural production. A large portion of the other two-thirds is engaged in the handling or in the manufacturing of agricultural products. Agriculture adds to the wealth of the state a half billion dollars a year in raw products alone. All this wealth flows through the cities of California, through the small towns at the edges of the farming area into the county-seats and the larger cities and then through the three or four great cities of the state to the markets of the world. Each town and city takes its toll of the farmer's prosperity. No city in California, nor anywhere else for that matter, could get along without the farmer.

In most of the affairs of life the cities recognize this and conduct themselves so as to co-operate with and serve the farmer, but in the matter of municipal ownership they proceed as if the farmer did not exist. They assume that their electric service is something separate and apart from his electric service. They do not admit that they should share costs in their congested areas with costs in the wide spread areas of the back country.

Yet electric service at the lowest feasible rates is vital to agriculture and it is important to the cities that the back country should receive electric service. All the elements of the community should receive electric service. All the elements of the community are dependent upon each other, cities upon farms and farms upon cities. Rural customers have a right to be served through the same system that serves the city dwellers and in the fixing of rates they have a right to be considered not as isolated consumers but as consumers of a general system that serves cities and towns and farms alike.

No one may question that California is forging ahead on a sound basis. One of the very important contributing factors to its progress has been recognition of the interdependence of city and country in the development of the power industry. It will be costly to all of us if we ever lose sight of the large aspects of the inter-relation and mutual interests of all parts and all sections of the state.

Even when large areas are brought under public ownership, the farmer does not benefit. An outstanding example is provided by the Province of Ontario in Canada. There electric service is controlled by the Ontario Hydro Electric System, owned by the Province. It covers a territory as large as the great region we call Northern California. It serves cities, towns and country districts.

But one need take only the official utterance of the Ontario Hydro-Electric Commission to learn that the farmer does not fare well in Ontario. Not long ago the chief engineer of that Commission wrote a letter to prospective customers quoting Ontario farm rates. For a four horsepower installation and a monthly consumption of 40 kilowatt hours, a very modest use, he said the annual bill to the Ontario farmer would be $82.42. In Northern California the annual bill for exactly the same service would be only $36, less than half as much. Various other rates for larger installations and larger consumption were quoted, and in each instance the difference in favor of the California farmer was proportionately the same. And when it came to heavy farm service, with a twelve horsepower installation and a monthly consumption of 150 kilowatt hours, the Ontario farmer's bill would climb to $205.49 a year, while the California farmer was obtaining precisely the same service for $93.30.

Can we wonder that Ontario's agricultural districts can boast of only two and one-half per cent of electrified farms? In California, not two and one-half per cent but 62 per cent of the farms of our state are electrified.

In the United States the task of putting the agricultural workers on an even footing with the industrial and commercial workers of the cities is everywhere well under way. American business initiative and American inventive genius, brought together under State-regulated private ownership, are fast overcoming obstacles to general rural electrical distribution that were once deemed insuperable. The goal is yet distant, for many problems must be solved before the United States will be able to boast of 1,500,000 electrified farms, but, unless politics is permitted to dull initiative and paralyze energy, that day will come far sooner than we at present dare to hope. The soul of America is in the electrical industry, and even now there are men who dream of a nation from whose every farm drudgery has been banished by the magic current that frees labor as it enriches lands.



The "Pacific Service" honor roll. The above portraits are of ten former employees whose long and faithful service has earned them honorable retirement.

The "Pacific Service" Roll of Honor

Heading the honor roll of "Pacific Service" are 83 names of men whose long and faithful service to our company has been rewarded by their honorable retirement with provision for their declining years under our company's pension system, which underwent complete revision in the fall of 1921.

In preceding issues we presented the portraits of men whose names are upon our company's pension roll, accompanied by their service records. In doing this we were actuated by a desire to make our readers acquainted with these men and their records and to point out what is generally recognized in all up-to-date business enterprises, namely, that long and faithful service shall have its reward.

Opposite this will be found another installment of ten portraits of our company's pensioners. These are:

Gus Anderson. 72 years of age. Entered the service of the Pacific Gas and Electric Company January 1, 1904, and at the time of retiring on a pension July 1, 1926, was employed in Drum Division.

Geo. A. Colwell. 70 years of age. Entered the service of the Pacific Gas and Electric Company April 1, 1904, and at the time of retiring on a pension July 1, 1926, was employed in Drum Division.

Edward James Angelo. 67 years of age. Entered the service of the San Francisco Gas Light Company in March, 1888, and at the time of retiring on a pension June 1, 1926, was employed in San Francisco Division.

Joe Silva. 67 years of age. Entered the service of the Oroville Electric Corporation on January 3, 1903, and at the time of retiring on a pension June 1, 1926, was employed in Colgate Division.

John H. Donovan. 67 years of age. Entered the service of the San Francisco Gas Light Company in July, 1884, and at the time of retiring on a pension March 1, 1925, was employed in San Francisco Division.

Thos. J. Cox. 67 years of age. Entered the service of Pacific Gas and Electric Company August 1, 1904, and at the time of retiring on a pension September 1, 1926, was employed in East Bay Division.

David Barnes. 65 years of age. Entered the service of the Capital Gas Company on April 1, 1889, and at the time of retiring on a pension November 1, 1926, was employed in Sacramento Division.

Daniel Riordan. 65 years of age. Entered the service of the Oakland Gas, Light and Heat Company on November 19, 1900, and at the time of retiring on a pension November 1, 1926, was employed in East Bay Division.

Thos. Oliver. 62 years of age. Entered the service of the Pacific Gas and Electric Company in May, 1905, and at the time of retiring on a pension July 1, 1926, was employed in Drum Division.

Chas. Robert Cathcart. 50 years of age. Entered the service of the San Francisco Gas and Electric Company June 1, 1904, and at the time of retiring on a pension November 1, 1926, was employed in East Bay Division.

Gas Service in the Railroad Shops

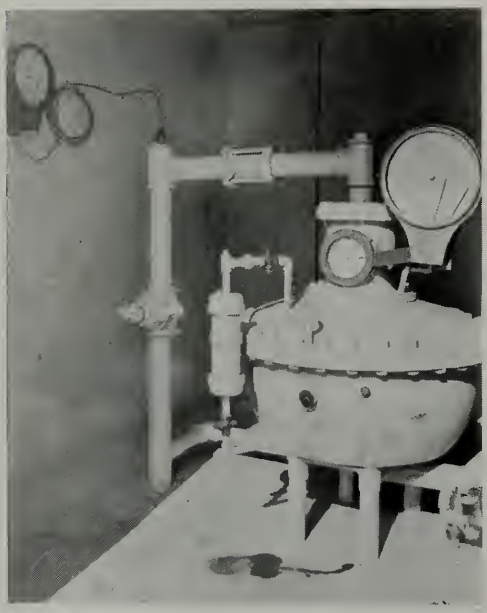
The Western Pacific Railroad first started to use city gas in its Sacramento shops in June, 1923. At this time only small appliances, such as soldering furnaces and hand-preheating torches, were installed. Later, city gas was used for metal cutting along with oxygen. By doing this acetylene was replaced, effecting a saving because city gas is cheaper than the former. Another advantage in using city gas is the fact that when the cutting is completed the article may be put into a lathe or shaper and machined without any danger of dulling the cutting tools. Using acetylene and oxygen, the material cut retains a semi-case-hardened surface approximately 15/1000ths of an inch in thickness which will dull the cutting tools if it is machined. A comparison of costs in using city gas and oxygen as against acetylene and oxygen follows:



Flue-heating furnace—Western Pacific shops.

	City Gas		Acetylene	
Test Number	1	2	1	2
Thickness of material in inches	6"	1 1/16"	6"	1 1/16"
Pressure of Oxygen in pounds	85	40	110	40
Pressure of Gas in pounds	21	25	15	15
Cubic feet of Oxygen used	128	48	100	36
Cubic feet of Gas used	7.7	3.3	7.0	7.0
Cost of Oxygen	$1.344	$0.504	$1.05	$0.378
Cost of Gas.....	0.006	0.003	0.193	0.193
Cost of Labor....	0.15	1.15	0.15	1.15
Cost for fifteen minutes	$1.50	$0.66	$1.39	$0.72
Lineal inches cut..	27¾	59½	19	37½
Cost per 100 lineal inches.....	$5.40	$1.10	$7.33	$1.92

The above figures are given through the courtesy of the Victor Oxy-Acetylene Equipment Co., 842 Folsom St., San Francisco, Calif.



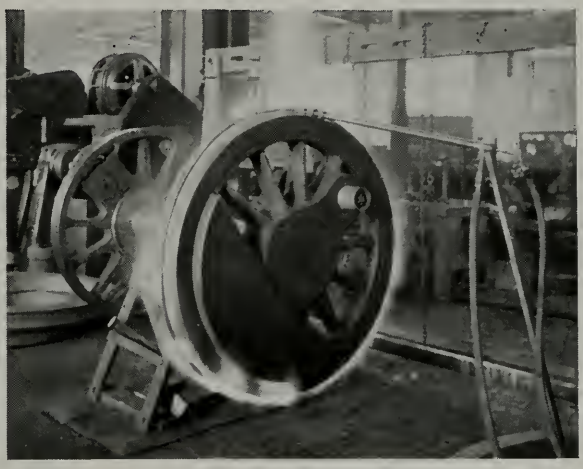
High-pressure meter installation at Western Pacific railroad shops.

From the above figures it is seen that city gas is much cheaper than acetylene. Another factor in favor of city gas is the fact that it may be piped all over the shops; it is always on hand. It is not necessary to buy steel containers, and the labor and transportation attached to handling are done away with.

About this same time, gas-fired rivet forges were installed, replacing the old coal-fired forges. These gas forges are portable and are moved to the work instead of bringing the work to the forge. The gas-fired forges have done away with smoke and eliminated the loss of rivets through overheating, as well as cutting the scale formation to a minimum.

The next installations were a spring furnace and carbonizing furnace. These furnaces are both about the same size, 56 in. by 36 in. by 16 in. At the present writing, the lining in the spring furnace has never been touched although the furnace has been in daily operation since 1923, when it was converted from oil to gas as a fuel. This is another instance why gas is the ideal fuel, because it saves wear and tear on furnace linings, thereby preventing costly shutdowns and repairs. The furnace atmosphere is controlled, resulting in the absence of scale. Other big and very important factors in favor of city gas as a fuel are those of safety and ease of control. These furnaces are safe because there is no danger of a back-fire.

The next installations were two flue-heating furnaces, which are used for heating flue-ends prior to cutting with a circular saw. City gas replaced kerosene as fuel for heating the flues. Following are data obtained from the operation of the spring furnace and the flue-heating furnace:



Tire heater—Western Pacific shops.

Spring Furnace

Average consumption per day (8 hours)	5789 cu. ft.
Cost per day at rate of 400,000 cu. ft. per month	$4.55
Average weight of springs put through per day	2012 lbs.
Cost per lb. for heating springs	$0.0022

Note: These springs have to be put through the furnace a second time after plunging in oil, which is not taken into consideration in figuring weight of metal put through furnace.

Flue Furnace

Average consumption per day (8 hours)	4090 cu. ft.
Average cost per day, same basis as above	$3.23
Average number of flues (2″) per day	320
Average cost per flue for heating	$0.0101

Note: These flues were heated with safe end preparatory to welding.



Rivet forge—Western Pacific shops.

A gas-fired ring-burner for heating locomotive tires is used in place of one which formerly used gasoline or kerosene as fuel. The advantages of city gas in this operation are that it leaves the tires free of soot, is faster in operation and, above all, absolutely safe.

During the latter part of 1925 a big plate-annealing furnace was converted from oil to city gas as fuel. This furnace is 10 ft. by 14 ft. by 3 ft. Formerly six oil-burners were used in this furnace; these were replaced by six high-pressure gas burn-

ers. Before using gas much metal was lost due to the formation of scale on the plates, as a result of the oxidizing action of the oil-air atmosphere of the furnace. Now this scale loss is reduced to a minimum, there being little, if any, formed. The plates are softer and this enables them to be worked much easier than before the change to gas. The furnace requires about one hour and fifteen minutes to reach the operating temperature. After this temperature is reached plates may be annealed at the rate of one every twelve to fifteen minutes. No difficulty is experienced in starting the cold furnace. Using city gas, it is only a matter of two or three minutes until all burners are lighted and operating perfectly.

The latest installations of gas-fired equipment are two furnaces which formerly used oil as a fuel. These are a bull-dozer furnace and a rod-annealing furnace. The bull-dozer is used for heating all kinds of small forgings, while the rod-annealing furnace is used for annealing side-rods, main rods, draw bars, driving boxes, draw bar equalizers and other miscellaneous parts. These furnaces are giving very good results and are used every day.

With the exception of the soldering furnaces and the tire heater all of the equipment in the Western Pacific shops is furnished with city gas at ten pounds per square inch pressure.



Carbonizing furnace—Western Pacific. Fired with four Surface Combustion Co. high-pressure tunnel burners.



Furnace used for making locomotive springs—Western Pacific—operated at 1800° F. Production doubled over oil furnace with same crew of men.

The Southern Pacific railroad shops, which are also located in Sacramento, are another of our large consumers of city gas for industrial purposes. In these shops city gas is used for brazing, in bench-furnaces, babbitt heaters, tinning and galvanizing furnaces. The new station uses gas for cooking in its restaurant, which formerly used oil. Another oil-replacement was made in their hospital.

Summing up, we can confidently say that these big industries rely on city gas as a fuel because a great deal of economy is effected over the equipment which was formerly used and fired by crude oil, from the standpoint of cleanliness, convenience, safety and saving in time of heating and ease of control. Too much can not be said of the safety of city gas as a fuel in comparison with various other fuels. Though yielding place to its younger rival, electricity, as a lighting agent, this hundred-year-old commodity is in greater demand today than ever as its value as a heating agent becomes universally recognized.

The Financial Side of "Pacific Service"

Following is a preliminary statement of the Company's income account for the calendar year 1926, compared with the preceding year:

INCOME ACCOUNT
TWELVE MONTHS ENDED DECEMBER 31ST

	1926	1925	INCREASE
Gross revenue, including miscellaneous income	$51,125,990.41	$48,066,897.07	$3,059,093.34
Maintenance, operating expenses, rentals, taxes (incl. Federal taxes) and reserves for casualties and uncollectible accounts	29,654,474.85	28,898,712.05	755,762.80
Net Income	$21,471,515.56	$19,168,185.02	$2,303,330.54
Net interest charges	7,926,006.24	7,078,183.24	847,823.00
Balance	$13,545,509.32	$12,090,001.78	$1,455,507.54
Bond discount and expense	457,419.14	430,654.27	26,764.87
Balance	$13,088,090.18	$11,659,347.51	$1,428,742.67
Reserve for depreciation	4,228,849.74	3,807,990.49	420,859.25
Balance to Surplus	$ 8,859,240.44	$ 7,851,357.02	$1,007,883.42
Dividends paid on Preferred Stock (6%)	5,488,880.06	3,265,433.65	223,446.41
Balance	$ 5,370,360.38	$ 4,585,923.37	$ 784,437.01
Dividends paid on Common Stock (8%)	4,119,970.08	3,624,337.36	495,632.72
Balance	$ 1,250,390.30	$ 961,586.01	$ 288,804.29

The following explanatory comments may assist in interpreting the foregoing figures:

(1) The Company's gross revenues, for the twenty-first consecutive year, established a new high record. The increase of $3,059,093 in gross earnings, substantial though it is, falls short of measuring the true growth of business, for the reason that two decreases in gas rates which became effective in the latter part of 1925, resulted in reducing our customers' gas bills last year by approximately $1,335,000 from what they would have been under the average rates effective in the preceding year. To this extent, the Company's gas consumers benefited through the policy, established by the Railroad Commission over five years ago, of automatically adjusting rates to offset changes in the price of fuel oil used in gas manufacture. Except for these lower rates in the Gas Department, which were of course offset by a corresponding decrease in the Company's fuel oil costs and did not affect the net return from gas operations, the increase in gross would have approximated $4,400,000.

(2) The gross operating revenue of the Electric Department increased $3,070,041, of which approximately $3,000,000 was due to additional sales of electricity, and the balance to the acquisition during the year of several relatively small distribution systems.

(3) The growth in volume of sales in the Gas Department, measured in terms of 1925 gas rates, was approximately $1,493,000, but this growth was very largely offset by the lower average rates in 1926 to which reference has previously been made, the actual increase in Gas Department revenues being $157,649. The Sacramento Gas Company, with annual gross earnings exceeding $360,000, was absorbed in the early months of the year.

(4) Operating expenses increased $755,763, or 2.6%. This increase is small when compared with the larger volume of business transacted, expressed in terms of physical units, and measured by increases of 12.0% in sales of electricity, 7.9% in sales of gas and 7.5% in the number of customers served. Every item of operating cost was kept under the most careful surveillance throughout the year.

(5) Net income available for the payment of bond interest amounted to $21,471,516, or $2,303,331 more than in the preceding year. The additional charges against income due to the new capital employed in the service of the public, as reflected in the

aggregate increase in fixed charges and in preferred and common stock dividends, amounted to $1,593,667. These additional charges, however, as well as an increase of $420,859 in depreciation reserve, were considerably exceeded by the growth in net, the final result of the year's operations being that a balance of $1,250,390, or $288,804 more than in 1925, was carried to surplus account after the payment of common stock dividends at the established rate of 8% per annum.

(6) As between the various classes of securities outstanding, it may be briefly stated that bond interest amounting to $7,926,006 was earned 2.7 times, and preferred stock dividends aggregating $3,488,880 were earned 2.5 times, leaving a balance for common of $5,370,360, equivalent to 10.43% upon the average common stock outstanding during 1926, or 10.16% upon the total outstanding at the close of the year.

From the standpoint of physical operations, it is interesting to observe that the number of customers connected to the Company's lines at the close of 1926 was 874,724, compared with 421,794 at December 31st, 1916, a gain in ten years of upwards of four hundred and fifty thousand active meters, or more than one hundred per cent. The net addition of new consumers last year was 61,026, of whom 10,557 were added through the acquisition of existing systems, and 50,469 represented the increase resulting from a steadily growing population and the unremitting activities of the sales forces.

Both gas and electric departments registered new peaks in output very substantially in excess of those achieved in any previous year. Sales of electricity amounted to 1,510,951,504 kilowatt hours, an increase of 161,848,655 kilowatt hours, or 12.0%. The volume of gas sold was 17,480,201,900 cubic feet, an increase of 1,279,250,900 cubic feet, or 7.9%. These large gains reflect in no uncertain manner a continuation of the consistently upward trend in volume of business which has been recorded year after year, the cumulative effect of which is demonstrated by the fact that the Company's sales of electricity have practically trebled in the past decade, while gas sales, as well as the total number of customers served, have more than doubled in the same period.

CHANGE IN PAR VALUE OF SHARES

At a special meeting held on October 11, 1926, the Company's stockholders approved the amendment of its articles of incorporation for the purpose of changing the par value of both its first preferred and common stocks from $100 to $25 per share. The effect of this change is to make each share of the old stock, for all purposes, the equivalent of four shares of new stock. This action was recommended to the stockholders by the Company's Board of Directors in the conviction that the proposed smaller stock units would add to the marketability of the Company's shares and facilitate their distribution among investors.

The change in par value became effective on Monday, January 3, 1927, and all certificates of stock thereafter issued will be in $25 per share denominations. Exchanges of old for new shares, in the proportion of four new $25 shares for each $100 share surrendered, may be made at any time to suit the convenience of holders. Until such exchange is effected, the old shares remaining in the possession of the owners will be the equivalent, for all purposes, of four of the new shares, including voting power, amount of dividends and the exercise of rights to purchase common stock that may be offered to common stockholders.

COMMON STOCK—PAR OFFERING NO. 2

In furtherance of the policy, announced over a year ago, of financing a portion of the Company's capital requirements through periodical offerings of common stock, at par, to existing owners of that issue, the Board of Directors on December 15, 1926, adopted a resolution extending to all holders of common of record at the close of business on January 26, 1927, the right to subscribe, at its par value of $25 per share, to an additional

issue of common stock to the extent of 10% of the par value then owned. Full details of the second par offering are contained in a circular letter addressed to common stockholders by President Creed under date of January 5, 1927.

The initial offering of this character, which was made in February, 1926, amounted to $4,813,000 par value of common stock, all of which was subscribed for within the prescribed time limit, with the exception of less than 800 shares ($100 par value). In other words, the owners of less than one-sixtieth of the outstanding common shares failed, either through negligence or through a misunderstanding of the facts, to avail themselves of the opportunity thus afforded to purchase additional stock at a cost very substantially below the prevailing market price. It is the hope of the management, now that the stockholders have had an opportunity of becoming more familiar with offerings of this character, that none of the holders of common stock will fail to take advantage of this second par offering.

Warrants evidencing the rights to subscribe will be issued and mailed on or before February 9, 1927, to each holder of common stock who may be entitled thereto. It is important to observe that subscription may be made only by signing the proper form on back of warrants and delivering them before close of business on March 1, 1927, to the Company's Transfer Office in San Francisco or to the Bankers' Trust Company, New York City. Stockholders receiving these warrants should remember that they possess a marketable value, and if it is not desired to exercise the right to subscribe for additional stock, the warrants may be sold in the open market through banks or stock brokerage houses in New York, San Francisco and other financial centers.

Warrants not used for subscribing on or before March 1, 1927, will be void.

OFFERING OF STOCK TO EMPLOYEES

Acting in conformity with a recent resolution of its stockholders, the Company is offering a limited amount of its stock for sale to its employees on favorable terms. The stock will be sold in units consisting of four shares of preferred stock and four shares of common stock of the par value of $25 per share. The price per unit is the same as the par value, namely $200, and employees are thus enabled not only to subscribe for both classes of stock upon very easy installment terms, but to participate in the purchase of common stock upon the same favorable price basis as that afforded from time to time to common stockholders.

Any employee of the Company who has been in the service one year or longer is entitled to subscribe for at least one $200 unit, his maximum subscription, however, being limited to five times his monthly salary or wages. The stock is to be paid for in installments covering a period of thirty-seven months, which makes the amount of monthly payroll deduction per unit relatively small. Employees are credited with interest on installments during the subscription period.

Prior to the present offering, over 2,700 of the Company's employees were already stockholders, holding an aggregate of approximately three million dollars par value of preferred and common stock, or an average of $1,100 par value of stock per employee-stockholder. It is anticipated that the new offering, which consists of $1,000,000 par value of preferred stock and $1,000,000 par value of common stock, will result in a substantial addition to the number of employees who are thus becoming part owners of the business in which they are engaged.

Aside from the obvious benefits to employees arising out of the incentive thus furnished to thrift and self-advancement, this employee-ownership is naturally of advantage both to the Company and to the general public, through the added individual and collective effort of the personnel to achieve that efficiency and economy in operation which is the surest foundation of continued prosperity.

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVI JANUARY, 1927 NO. 11

This newborn year of 1927 promises well. Fall rains drenched our State from end to end and laid good foundation for a solid wall of snow on the mountain tops. It looks like a long, open winter, and if early promise holds out there will be crops a-plenty and good water for the farmer during the irrigating season.

These are the days of active construction work in every section of "Pacific Service" territory. New projects are in process, and with our steadily increasing population and agricultural and industrial growth there is an ever pressing need for extensions and betterments of distribution facilities, both gas and electric.

On the electric side, the close of 1926 found four major hydro-electric projects well under way. Taking, first, that nearest the Sierra Nevada summit, the work of raising the dam at Lake Fordyce and thereby doubling the storage capacity of the reservoir, was completed before the snows came. A deal of important reconstruction work will be in order in the spring to prepare the Spaulding-Drum system for the additional water supply that after use for power generating purposes will give sustenance to the deciduous fruit lands of the foothill country around Auburn and Newcastle. This Spaulding-Drum system comes into prominence again through our company's agreement with the Nevada Irrigation District, details of which will be found elsewhere, and during the present year the work of enlarging Drum canal will be completed; also, the work of increasing the power-generating facilities at Spaulding Nos. 1 and 2 plants will be effected, and not only will work be started on Spaulding No. 3 plant at the east end of the lake, but it is expected to complete the greater part if not all of the installation before the close of the year. During the winter time the tunnel that carries the water from Spaulding dam into Bear valley will be enlarged, and when summer comes the work of laying a second penstock line from Drum forebay to the power-house will be completed and a fourth generating unit installed in the power-house itself. It may be safely predicted that the entire system will be in position to take care of the water supply from Bowman and other reservoirs of the Nevada Irrigation District as well as the increased output from Fordyce in plenty of time for the irrigating season of 1928.

Traveling over to the Stanislaus, it is announced elsewhere that the Melones power plant in process of construction through cooperation with the South San Joaquin and Oakdale Irrigation Districts will be completed by June 1st. The tunnel is bored, also the foundation for the power-house, and the transmission line towers are up. There remains but the finishing process and the installation of the machinery to make the plant a going concern.

In the region of the Mother Lode the close of 1926 found our company's Tiger creek project on the Mokelumne well under way, with all but two miles of the road leading to the Salt Springs dam site from the Alpine highway complete. During the present winter construction work will be started on a lower level road leading in from the Barton place on the highway some twenty miles above Jackson and about fifteen miles on the Jackson side of the other road. This road, when completed, will be open all the year round and will enable transportation of machinery and supplies to the Tiger creek power-plant, and on to the Salt Springs dam site twenty-five miles farther upstream. The construction power line into Salt Springs is three-fourth complete. During the present year the two roads into the dam site will be completed and construction camps established. This Tiger creek project is a four-year job, and is of such picturesque character as well as interesting from the engineering standpoint that it is proposed to furnish our readers details of progress from time to time.

Taking a flight northward, work on Pit No. 4 project has been concentrated upon the building of the diversion dam, all foundations of which have been finished and three-fourths of the concrete poured. The tunnel intake structure is also completed. This year will see all construction work on the dam finished and the large drum gates on the crest in place.

There will be a considerable amount of substation work, particularly in the interior. A prominent item on the schedule is a new substation at San Jose, which will enable an increase of the voltage of the Newark-San Jose transmission lines from 60,000 to 110,000, an increase necessary to better supply the growing load in that territory. In the steam-electric way the feature of interest will be the installation of a new generating unit of 37,500 kilowatt capacity at our company's Oakland station. This installation will replace a very much smaller unit that has grown obsolete and will add to the Oakland station's installed generating capacity approximately 40,000 horsepower.

The electric department expects to expend approximately $14,000,000 on new construction during the present year.

In the program of expenditures electricity's hundred-year-old competitor, gas, is not forgotten. The prominent features of the 1926 record include the construction and installation of a new gas-holder of the waterless type at 50th and Clement Streets in Oakland, and the revival of coal-gas manufacture at Marysville. In the 1927 budget the sum of $5,267,650 is marked for expenditure in gas distribution improvements to take care of the steady increase in consumers and demand. Following an up-to-date policy there will be much done in the way of extending service to the rural districts through high-pressure lines. San Francisco is allotted the lion's share of the expenditures with $1,516,220, while East Bay Division comes second on the list with $1,403,900.

It is a matter of common knowledge now that the State of California leads the Union in hydro-electric development and is the largest consumer of electricity per capita of anywhere in the world. Our State, through its men of daring and initiative, has pioneered in every phase of hydro-electric development, and her achievements in this respect have attracted the attention of engineers in every section of the civilized universe, so that they have thought it worth while to undertake the long journey across the continent for the purpose of seeing things for themselves.

Reducing California's record to terms of figures we present to our readers the following statistics covering electric development in California as of January 1, 1927:

Electric consumers (total), 1,599,315.

Wired homes, 1,230,450.

Commercial lighting consumers, 264,685.

Industrial power consumers, 104,180.

Installed capacity (hydro), 1,377,424.

Installed capacity (steam), 709,870 kw.

Installed capacity (total), 2,087,294 kw.

Kilowatt-hour generation, 1926, 6,898,000,000 kw.-hrs.

Percentage of wired homes, 92 per cent.

Total connect load, 3,687,000 kw.

Connected load, domestic and commercial, 1,284,000 kw.

Connected load, agricultural, 461,000 kw.

Connected load, railway, 232,000 kw.

Connected load, mining, 95,000 kw.

Connected load, industrial, 1,339,000 kw.

Connected load, miscellaneous, 276,000 kw.

Industry is 78.8 per cent electrified in California.

With the largest annual increase in manufactured gas sales ever recorded, the year 1926 was the best in the history of the gas industry in the United States. Total sales for the year, officially reported by the American Gas Association, amounted to 459,326,000,000 cubic feet, an increase of practically 38 billion cubic feet over 1925, and an increase of 132 billion cubic feet or 40 per cent in the past five years.

The increase in 1926 sales, which brings the total to a new high record, is more than twice the increase shown in 1925 over 1924, and is almost as large as the combined increases shown in the three years 1920, 1921 and 1922.

The expansion of distribution facilities last year enabled the 984 gas companies to extend their services to 400,000 new customers, an increase of nearly four per cent in the number of customers, bringing the total to 11,000,000. With the extension of

distribution mains, there has been a parallel growth in plant and manufacturing processes, and also a decided increase in operating efficiencies.

Gross revenues from the sale of gas increased $39,776,000 in 1926 to a new high total of $491,776,000. The sale of by-products of gas manufacture has shown more than a normal growth.

One hears much, nowadays. about the American passion for law-making. It is not unusual to hear the statement made that an industrious State Legislature, such as, for instance, that of California, will enact more laws in one session than are to be found upon the statute books of the combined countries of Europe, etc., and so on. That being so, it is interesting to note that the abuse of "over-legislation" exercised the minds of public men in old England and, doubtless, other countries of Europe long before the speed mania descended upon them and held them in its relentless grip.

As far back as 1853 the famous Herbert Spencer wrote an essay upon this subject. Some excerpts therefrom might be interesting, not to say amusing to our readers. We offer the following:

"Take up a daily newspaper and you will probably find a leader exposing the corruption, negligence or mismanagement of some State department. Cast your eye down the next column and it is not unlikely that you will read proposals for an extension of State supervision. Yesterday came a charge of gross carelessness against the Colonial office. Today Admiralty bunglings are burlesqued. Tomorrow brings the question, 'should there not be more coal-mine inspectors?' Now there is a complaint that the Board of Health is useless; and now an outcry for more railway regulation. While your ears are still ringing with denunciations of Chancery abuses, or your cheeks still glowing with indignation at some well-exposed iniquity of the Ecclesiastical Courts, you suddenly come upon suggestions for organizing 'a priesthood of science.' Here is a vehement condemnation of the police for stupidly allowing sightseers to crush each other to death. You look for the corollary that official regulation is not to be trusted, when, instead, apropos of a shipwreck, you read an urgent demand for government inspectors to see that ships always have their boats ready for launching. Thus, while every day chronicles a failure, there every day reappears the belief that it needs but an Act of Parliament and a staff of officers to effect any end desired."

Mr. Spencer waxes eloquent in this essay upon the inefficiency of the State government, pointing out abuses in its administration of justice, in its handling of the military and the navy, in its supervision of matters commercial, and comparing its achievements most unfavorably with those of private enterprise. The whole government of England, in fact, is called to account and the advocates of much government accused of building political air-castles. Says Mr. Spencer:

"They seem to have read backwards the parable of the talents. Not to the agent of proved efficiency do they consign further duties, but to the negligent and blundering agent. Private enterprise has done much, and done it well. Private enterprise has cleared, drained, and fertilized the country, and built the town; has excavated mines, laid out roads, dug canals, and embanked railways; has invented, and brought to perfection, ploughs, looms, steam-engines, printing presses, and machines innumerable; has built our ships, our vast manufactories, our docks; has established banks, insurance societies, and the newspaper press; has covered the sea with lines of steam-vessels, and the land with electric telegraphs. Private enterprise has brought agriculture, manufactures and commerce to their present height, and is now developing them with increasing rapidity. Therefore, do not trust private enterprise. On the other hand, the State so fulfills its judicial functions as to ruin many, delude others, and frighten away those who most need succor; its national defences are so extravagantly and yet inefficiently administered, as to call forth almost daily complaints, expostulation, or ridicule; and as the nation's steward, it obtains from some of our vast public estates a minus revenue. Therefore, trust the State. Slight the good and faithful servant, and promote the unprofitable one from one talent to ten."

The concluding paragraph of the famous English philosopher's essay sounds a familiar note. However, the public of today is the judge, and the public is disposed to be fair when it knows the facts.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 870,000 CONSUMERS OF

GAS ✦ ELECTRICITY ✦ WATER ✦ STEAM

2,472,404 Total Population Served in Thirty-eight of California's Counties

CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL	
	No.	Population	No.	Population	No.	Population
Electricity	248	1,650,294	48	218,170	296	1,868,464
Gas	70	1,660,800	6	20,702	76	1,681,502
Water (Domestic)	24	90,800	6	19,550	30	110,350
Railway	1	105,000			1	105,000
Steam Heating	2	1,003,000			2	1,003,000

Place	Population
[1]Alameda	35,140
[2]Albany	6,000
Alamo	100
Alleghany	300
Alta	100
Alvarado	1,120
Alviso	640
[5]Amador City	750
Anderson	1,180
Angel Island	500
Antioch	2,800
Applegate	100
[6]Aptos	200
Arbuckle	900
Artois	200
Asti	100
[2]Atherton	800
[5]Auburn	3,000
Bangor	50
Banta	50
[2]Barber	500
[2]Belmont	1,000
Belvedere	750
Benicia	2,750
[6]Ben Lomond	500
[2]Berkeley	80,000
Bethany	50
[6]Biggs	750
[6]Big Oak Flat	150
Bolinas	400
Boyes Springs	1,000
Brentwood	500
[2]Broderick	800
Browns Valley	125
[2]Burlingame	13,150
Butte City	200
Byron	400
Calistoga	1,000
[2]Campbell	1,500
Camp Meeker	300
Cana	500
[6]Capitola	450
[6]Carmel	2,500
Cement	1,000
Centerville	1,775
Ceres	1,100
[2]Chico	12,000
Chico Vecino	2,500
Cloverdale	1,000
[5]Colfax	800
College City	250
Collinsville	300
[2]Colma	2,900
[5-6]Columbia	400
[2]Colusa	2,200
Concord	4,200
Copperopolis	300
Cordelia	350
Corning	1,800
[2]Corte Madera	1,000
[2]Cotati	600
Cottonwood	704
Coyote	250
Crockett	2,500
Crows Landing	300
[2]Daly City	6,500
Danville	500
Davenport	500
[2]Davis	1,750
Dayton	60
Decoto	700
[6]Del Monte	300
Denair	400
[6]Dixon	1,200
Dobbins	100
Drytown	200
Duncan's Mills	250
Durham	600
[5-6]Dutch Flat	400
Dunnigan	150
Eldridge	500
[2-6]El Cerrito	3,000
Elmira	300
El Verano	500
[2]Emeryville	5,000
Empire	250
Escalon	700
Esparto	600
[2]Fairfax	1,200
Fairfield	1,200
Fair Oaks	500
Fall River Mills	316
Farmington	300
[6]Felton	300
Finley	100
Folsom City	1,500
Forest City	200
Forestville	300
[6]French Gulch	170
[1]Fresno	72,000
Gerber	400
Geyserville	750
[6]Gilroy	3,700
Glen Ellen	1,200
Gold Run	50
[6]Gonzales	500
Graton	250
[3-8]Grass Valley	6,000
[6]Gridley	2,500
Grimes	500
[6]Groveland	250
Guerneville	1,200
[6]Hamilton City	300
Hammonton	500
[2]Hayward	5,000
[6]Healdsburg	3,000
[6-7]Hercules	600
Hickman	40
[2]Hillsborough	1,000
[6]Hollister	4,500
Honcut	500
Hopland	500
Hughson	625
[5]Ione	900
Irvington	1,200
[5-8]Jackson	2,500
[5-6]Jamestown	1,000
Kelseyville	600
Kennett	492
[2]Kentfield	1,000
Kenwood	300
Keswick	20
[6]King City	1,600
Kingston	100
Knights Ferry	200
Knights Landing	525
La Fayette	300
[5]La Grange	200
Lakeport	1,250
[2]Larkspur	1,000
Lathrop	300
[2]Lawndale	60
Lewiston	100
[5-8]Lincoln	2,000
Live Oak	1,000
[5]Livermore	3,600
[1]Lodi	5,000
[2]Lomita Park	1,325
[5]Loomis	500
Los Altos	1,800
[2]Los Gatos	4,750
Los Molinos	460
Lytton	100
Madison	300
Magalia	100
Manteca	2,000
Manton	65
[2]Mare Island	600
[5]Martell	100
Martinez	7,000
[2]Marysville	8,500
Maxwell	600
McArthur	167
[2]Menlo Park	3,500
Meridian	250
[2]Millbrae	350
Mills	400
[2]Mill Valley	3,500
Millville	200
Milpitas	400
Mission San Jose	500
Modesto	17,000
Mokelumne Hill	237
[6]Monterey	6,900
Monte Rio	500
[6]Morgan Hill	1,200
[2]Mountain View	3,000
Mt. Eden	500
[2]Napa	7,000
Nelson	50
[3-8]Nevada City	1,800
Newark	1,100
[5]Newcastle	750
Newman	1,250
Niles	1,850
Nord	60
[2-6]Novato	1,000
[1]North Sacramento	2,500
Oakdale	2,000
[2-9]Oakland	295,000
Oakley	300
Occidental	600
Orland	2,100
[3]Oroville	7,000
Pacheco	300
[6]Pacific Grove	5,000
[2-6-7]Palo Alto	9,550
Paradise	600
Patterson	700
[2]Penn Grove	250
[5]Penryn	250
Perkins	350
[2]Petaluma	7,500
[2]Piedmont	9,000
[6-7]Pinole	1,000
Pitt burg	8,500
Pleasanton	1,800
Port Costa	990
Potter Valley	600
Princeton	300
[2]Red Bluff	3,500
[3-6]Redding	5,000
[2]Redwood City	8,000
[2-6]Richmond	28,700
Richvale	500
Rio Nido	250
Rio Vista	1,100
Ripon	1,000
Riverbank	1,200
[5]Rocklin	700
[6-7]Rodeo	900
[6-8]Roseville	7,000
[2]Ross	900
[4]Sacramento	105,000
Salida	300
[6]Salinas	6,500
San Andreas	600
[2]San Anselmo	4,500
[2]San Bruno	2,175
[2-9]San Francisco	708,000
[2]San Jose	68,000
[6]San Juan	500
[2]San Leandro	12,000
[2]San Lorenzo	1,000
[2]San Mateo	11,500
[2-6]San Pablo	1,500
[2]San Quentin	3,500
[2]San Rafael	7,800
[6-7]Santa Clara	6,500
[6]Santa Cruz	17,500
[2]Santa Rosa	14,000
Saratoga	1,300
[2]Sausalito	3,800
[2]Sebastopol	2,000
Shawnut	100
Shasta	46
Shellville	200
Sheridan	50
Smartsville	300
[6]Soledad	475
[6]Soquel	875
Sonoma	1,000
[5-6]Sonora	3,500
[5]Soulsbyville	200
[2]South San Francisco	6,500
Standard	800
[2-7]Stanford University	3,652
Stanislaus	100
[5-6]Stockton	55,000
Suisun	800
Sunol	500
[2]Sunnyvale	2,700
Sutter City	500
[5]Sutter Creek	1,000
Tehama City	200
[6-8]Thermalito	250
Thornton	135
Tiburon	500
[5]Towle	50
Tracy	4,500
[6]Tres Pinos	400
[5-6]Tuolumne	1,500
Turlock	5,000
Upper Lake	750
[6]Vacaville	1,300
Valley Home	200
[2-6]Vallejo	22,7500
Vina	300
Vineburg	250
Walnut Creek	2,500
Warm Springs	300
Waterford	400
[6]Watsonville	7,300
[6]Weaverville	500
Wheatland	650
Williams	800
[3]Willows	3,000
Windsor	600
Winters	900
[2]Woodland	6,950
Woodside	300
Wyandotte	250
Yolo	400
[2]Yuba City	4,000
Zamora	100
Total Cities and Towns	1,983,104
Add Suburban Population	489,300
Total Population Served	2,472,404

Unmarked—Electricity only.
1—Gas only.
2—Gas and Electricity.
3—Gas, Electricity and Water.
4—Gas. Elect. and St. Railways.
5—Electricity and Water.
6—Electricity supplied through other companies.
7—Gas supplied through other companies.
8—Water supplied through other companies.
9—Steam Heating.



Financial Independence—

rests upon the twin pillars of

Steady Saving *and* Intelligent Investment

Pacific Gas and Electric Company First Preferred Cumulative 6% Stock is a thoroughly sound, seasoned investment. ¶ It may be purchased on the partial payment plan, thus affording an ideal means of steady saving. ¶ More than 24,000 discriminating investors, in every station of life, now own this stock. Thousands of them have thus invested their first savings. ¶ Why not lay the foundation of *your* financial independence *now?*

Write or telephone for circular descriptive of this investment

PACIFIC GAS AND ELECTRIC COMPANY

Stock Sales Department

245 Market Street · San Francisco

PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO



"PACIFIC SERVICE" CROSSING THE MARIN HILLS
ON ITS WAY TO SAN FRANCISCO

Vol 16 — APRIL 1927 — No 12

PACIFIC GAS AND ELECTRIC COMPANY

DIRECTORS

WALLACE M. ALEXANDER	A. B. C. DOHRMANN	FRANK A. LEACH, JR.
FRANK B. ANDERSON	JOHN S. DRUM	NORMAN B. LIVERMORE
CHAS. L. BARRETT	F. T. ELSEY	JOHN A. McCANDLESS
W. E. CREED	D. H. FOOTE	JOHN D. McKEE
W. H. CROCKER	A. F. HOCKENBEAMER	C. O. G. MILLER

OFFICERS

W. E. CREED . . . . . *President*
FRANK A. LEACH, JR. . . . . *First Vice-President and General Manager*
A. F. HOCKENBEAMER . . . . . *Second Vice-President and Treasurer*
D. H. FOOTE . . . . . *Third Vice-President and Secretary*
CHAS. L. BARRETT . . . . . *Assistant Secretary*

MANAGEMENT OFFICERS

P. M. DOWNING, Vice-President in Charge of Electrical Construction and Operation
A. H. MARKWART, Vice-President in Charge of Engineering
W. G. VINCENT, Vice-President and Executive Engineer
W. S. YARD, Vice-President in Charge of Gas Construction and Operation
R. E. FISHER, Vice-President in Charge of Public Relations and Sales
J. P. COGHLAN, Assistant to the President

HEADS OF DEPARTMENTS

L. H. SUSMAN, Attorney . . . . . LAW DEPARTMENT
C. P. CUTTEN, Attorney . . . . . RATE DEPARTMENT
R. J. CANTRELL, Manager . . . . PROPERTY AND TAX DEPARTMENT
E. W. HODGES, General Auditor . . . ACCOUNTING DEPARTMENT
H. T. TERRY . . . . . CHIEF TRAVELING AUDITOR
GEO. H. RAND, Manager . . . . . CREDIT AND STOCK SALES DEPARTMENTS
JOHN H. HUNT, Purchasing Agent . . PURCHASING DEPARTMENT
GEO. C. ROBB, Superintendent . . . SUPPLY DEPARTMENT
E. G. McCANN, Manager . . . . . PERSONNEL DEPARTMENT

ELECTRICAL CONSTRUCTION AND OPERATION DEPARTMENT

O. W. PETERSON . . . . . Engineer of General Construction
E. H. STEELE . . . . . Engineer of Line Construction
F. R. GEORGE . . . . . Engineer of Operation
GEO. H. BRAGG . . . . . Engineer of Maintenance

DEPARTMENT OF ENGINEERING

J. P. JOLLYMAN . . . . . Chief of Division of Hydro-Electric and Transmission Engineering
S. J. LISBERGER . . . . . Chief of Division of Electric Distribution and Steam Engineering
I. C. STEELE . . . . . Chief of Division of Civil Engineering
F. M. HARRIS . . . . . Chief of Bureau of Specifications and Estimates
O. A. KNOPP . . . . . Chief of Bureau of Tests and Inspection

DEPARTMENT OF EXECUTIVE ENGINEER

F. C. PIATT . . . . . Valuation Engineer of Electric Properties
J. T. RYAN . . . . . Valuation Engineer of Gas, Water and Railway Properties
B. B. BECKETT . . . . . Rate Engineer
S. B. SHAW . . . . . Automotive Engineer
W. G. JACK . . . . . Manager Land Department

GAS CONSTRUCTION AND OPERATION DEPARTMENT

FRANK WILLS . . . . . Engineer of Production
R. S. FULLER . . . . . Engineer of Distribution
HARRY J. SMITH . . . . . Engineer of Construction

PUBLIC RELATIONS AND SALES DEPARTMENT

DON C. RAY . . . . . Manager Bureau of Public Relations
N. R. SUTHERLAND . . . . . Manager Commercial Department
H. M. CRAWFORD . . . . . General Sales Manager
R. T. STEPHENS . . . . . Manager Electric Sales
FORREST U. NAYLOR . . . . . Manager Gas Sales
J. CHARLES JORDAN . . . . . Manager Publicity Department

W. B. BOSLEY
General Counsel

F. S. MYRTLE
Editor-in-Chief Pacific Service Magazine

DIVISIONS AND MANAGERS

DIVISION MANAGERS		DISTRICT MANAGERS		HEADQUARTERS
E. C. JOHNSON	COLGATE DIVISION			Marysville
		C. R. GILL	Colusa District	Colusa
I. B. ADAMS	DE SABLA DIVISION			Chico
H. M. COOPER	DRUM DIVISION			Auburn
		L. H. HARTSOCK	Nevada District	Nevada City
		J. V. KYLE	Placer County District	Auburn
L. H. NEWBERT	EAST BAY DIVISION			Oakland
		J. H. PAPE	Berkeley District	Berkeley
H. C. ROSS	FRESNO DIVISION			Fresno
H. G. RIDGWAY	NORTH BAY DIVISION			San Rafael
		L. J. PETERSON	Petaluma District	Petaluma
		C. D. CLARK	Napa District	Napa
		C. D. CLARK	Vallejo District	Vallejo
		M. G. HALL	Santa Rosa District	Santa Rosa
E. W. FLORENCE	SACRAMENTO DIVISION			Sacramento
		C. E. SEDGWICK	Solano District	Dixon
HENRY BOSTWICK	SAN FRANCISCO DIVISION	J. W. COONS	Yolo District	Woodland
CHAS. S. NORTHCUTT	SAN JOAQUIN DIVISION			San Francisco
				Modesto
		W. E. ESKEW	Electra District	Jackson
		J. H. FAGG	Stockton District	Stockton
		CHAS. H. NOACK	Tuolumne District	Sonora
JOHN D. KUSTER	SAN JOSE DIVISION			San Jose
		W. T. KELLOGG	Redwood District	Redwood City
G. R. MILFORD	SHASTA DIVISION			Redding
H. B. HERYFORD	WEST SIDE DIVISION			Red Bluff
		STEPHEN GOIN	Willows District	Willows
		CHAS. HUGHES	Red Bluff District	Red Bluff

Pacific Service Magazine

Volume XVI *Number 12*

Contents for April, 1927

TOWER LINES AT SOUTH SAN FRANCISCO . . . *Frontispiece*

THE "PACIFIC SERVICE" RECORD FOR 1926
ITS LEADING FEATURES INCLUDE REFINEMENTS OF OPERATION AS WELL AS EXTENSIONS AND BETTERMENTS OF SERVICE FACILITIES . 375

PIT FOUR DIVERSION DAM AT POINT OF COMPLETION . . 376

POWER TRANSPORT AND DELIVERY—EXPRESS AND LOCAL SERVICE 378

AUTOMATIC TYPE A STRIKING FEATURE OF ELECTRIC SUBSTATION DEVELOPMENT 383

DOUBLING GAS STORAGE CAPACITY IN EAST BAY TO MEET CONDITIONS 388

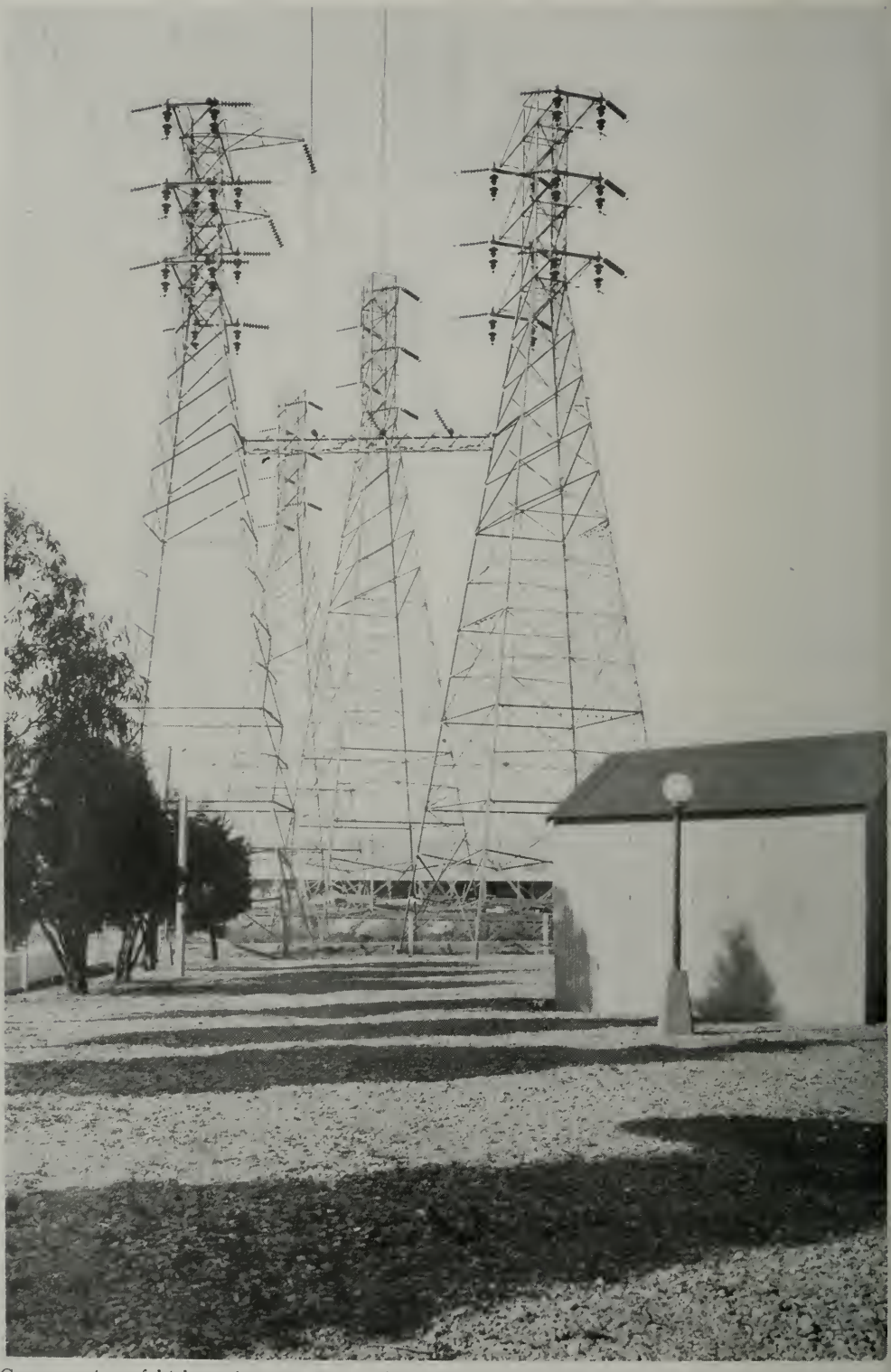
REVIVAL OF COAL AS A GAS-MAKING FUEL IN "PACIFIC SERVICE" TERRITORY 394

INTERESTING PROBLEMS INVOLVED IN RESEARCH AND EXPERIMENT 399

PUBLIC RELATIONS, PUBLICITY AND CREATIVE SALES CAMPAIGN 402

THE FINANCIAL SIDE OF "PACIFIC SERVICE" 403

EDITORIAL 406



Concentration of high-tension transmission lines at an important industrial center, South San Francisco. The towers in the foreground carry electric energy at 60,000 volts for local distribution through South San Francisco substation; those in the background are of the 110,000-volt transmission line between Newark and Martin high-voltage substations.

PACIFIC SERVICE MAGAZINE

Volume XVI APRIL, 1927 Number 12

The "Pacific Service" Record for 1926

Its leading features include refinements of operation as well as extensions and betterments of service facilities.

In presenting the twenty-first annual report of the Pacific Gas and Electric Company to the stockholders, President Wigginton E. Creed relates that, beginning with the year 1920, the company embarked upon a construction program of considerable magnitude in order to provide the additional generating, transmission and distribution facilities necessitated by the accumulative demand of several years of uninterrupted growth and to make adequate provision for future business expansion; that in the seven years from 1920 to 1926 a sum of $132,446,000, or seven times the amount expended in the preceding six years, was expended on new construction. In addition, several relatively minor systems representing an investment of $4,801,000 were acquired, so that the net additional investment in plants and properties aggregates $137,247,000. The report sets forth that of this total there was expended during the past year the sum of $19,667,215 for additions, betterments and improvements, to which sum must be added $1,692,084 expended for the purchase of other properties, making a total addition to fixed assets of $21,359,299.

It has been announced that during the present year there will be required a further sum of $20,000,000 for additions, betterments and improvements. A practical idea of what it means to keep so vast a system as "Pacific Service" in serviceable condition to meet the constantly increasing demands upon it may be gathered from the statement that this proposed expenditure includes no appropriations for new construction projects of any magnitude.

In his address to the stockholders at the annual meeting on April 12th, President Creed stated that the properties of our company are in the best physical condition they have ever been, with greater resources of gas and electric generating and distributing facilities than at any previous time in the company's history. The period of new construction work of a major character being, for the time being, at least, at an end, it is now a question of concentrating upon refinements of operation with the view of getting the best possible results from the great expenditures of the past seven years.

The year 1926 brought forth accomplishments of value in this direction. Some of the most interesting of these have been selected for description in this number.

EDITOR PACIFIC SERVICE MAGAZINE.

Pit Four Diversion Dam at Point of Completion

The diversion dam at Pit No. Four development is, at the time of writing, at point of completion. The concrete structure is already in place and all that remains is the completion of two steel gates on the crest of the overpour section, and the addition of certain minor details.

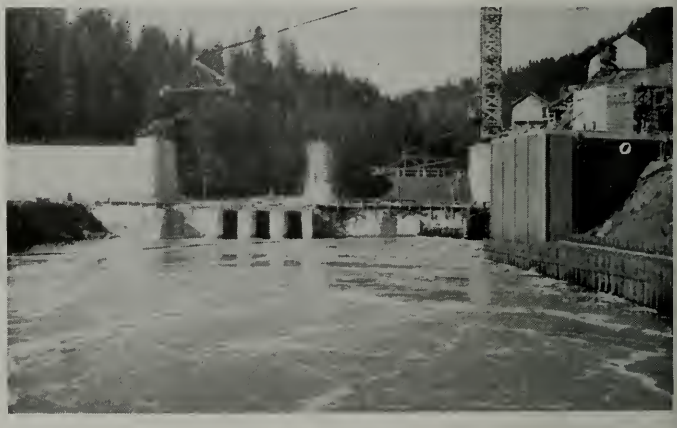
In point of picturesque attractiveness this development may not be as interesting as its predecessor, Pit No. Three; nevertheless owing largely to the peculiar formation of the river bed at the site, the dam construction involved engineering features of unusual character. At this point bedrock appears practically at the ground surface on the right bank of the river, but from this bank it drops below the stream to a depth of about fifty feet at the left edge of the river channel. Beyond the left bank its depth increases. The design for the dam, therefore, called for a composite structure, with a heavy overpour gravity section from the left edge of the channel to the right abutment and a lighter, non-overpour structure at the left side. This composite structure, then, which rises 60 feet above the stream bed and is of 400 feet in length, really consists of two dams, each of about 200 feet in length, placed end to end, the portion at the right bank being built on solid bedrock and of massive dimensions to carry any possible flood waters over its crest, that at the left bank being founded on a reinforced concrete slab laid over a broad, firm earth base with concrete cut-off walls extending below the stream bed to intercept possible seepage. Extending from the upstream toe of this slab a heavily reinforced concrete facing is carried up on a slope one-half horizontal to one vertical, receiving support at the rear from concrete buttresses at 18-foot centers.

Between the two sections of dam a massive division wall founded on solid rock, extending 170 feet up and down stream, 30 feet thick at the base and of 120 feet maximum height, serves as an artificial abutment for the overpour section and as a protective and retaining wall for the river edge of the hollow-type dam.

The downstream toe of the overpour dam is protected by a broad concrete apron and baffle piers as at Pit Three, the purpose of the piers being to absorb the energy of the waters rushing away from the dam.

The maximum height, from foundation to crest of abutments, is 120 feet, practically the same as Pit Three dam. Unlike the latter, however, the present construction involved much deeper excavation for its foundation.

Preliminary work started in October, 1925, and between that time and the end of the year the Pit River construction railroad had been extended from Pit Three power-house one and one-half miles downstream to Pit Four dam-site and a camp and construction plant had been erected. Also, considerable progress was made in the building of the temporary rock-crib diversion dam and large timber flume which were to serve for the unwatering of the



Pit Four diversion dam nearing completion. Upstream face of new dam. Tunnel intake at the right.

river channel at the site of the permanent dam in order to permit the work of excavating the foundations.

The waters were diverted on the first of May last, according to schedule, and from that time on excavation of the debris overlying the foundations of the dam proceeded energetically with the use of two power shovels loading into cars. This was a task of considerable magnitude, because the debris consisted mainly of very large boulders, and the excavation extended to a depth of 50 feet below stream bed.

At the right abutment and under the present river channel for a total width of 200 feet foundations were carried down to and into the solid bedrock. For an additional length of 200 feet bedrock pitched down to such a great depth that the foundations of the dam were carried for a maximum depth of about 25 feet into good firm earth, with cut-off walls extending below for an additional 10 to 33 feet.

By midsummer concrete pouring was proceeding at good speed, practically all concrete being spouted directly into place from the plant standing high on the right bank of the river. Along with the concrete operations was the setting of the three heavy sluice gates in the dam, together with the heavy cast-iron liners used in the sluice way tunnels.

Just upstream from the dam, at the right bank of the river, a reinforced concrete intake structure, similar to that installed at the head of Pit Three tunnel, was built along with the first 200 feet of tunnel.

Since the first of the year the principal work has been the erection of two large steel gates on the crest of the overpour section of the dam, backfilling and rock protection of the abutments at the left bank of the river, and the numerous smaller details that serve to produce a structure that will require the least possible human care and attention for its future maintenance and operation. Within a few weeks all this work will be finished.

Excavation for the dam required the removal of over 70,000 cubic yards of material, a volume considerably in excess of the concrete yardage that was placed over the foundations.

The total amount of concrete poured in the dam totals 42,000 cubic yards, three-fourths of which went into the heavy overpour gravity section and one-fourth into the highly reinforced hollow-type section.

With 2,000 acre-feet of storage between this dam and Pit Three power-house, the irregular flows from Pit Three will be absorbed into this reservoir and, in turn, diverted into Pit Four tunnel, when Pit Four plant is built. Thus it will serve as an afterbay for Pit Three and as a forebay for the future Pit Four development. Flows of water in excess of the requirements of Pit Four will normally be able to pass through the three sluice gates; for flood flows the two large hollow steel drum gates, each hinged at its upstream toe to the crest of the dam, will be depressed to permit water to pass over them. Each of these drum gates is 68 feet long and 14½ feet high. Thus we have on the top of the overpour section of the dam a movable crest 136 feet long and 14½ feet high. When these gates are down, water to a depth of 30 feet can pass over the crest of this portion of the dam without overtopping the hollow-type dam. The conception of the best type of structure to erect and the details of design represent a notable engineering achievement; likewise, its construction, much more complicated than that of the average dam, proceeding smoothly on a prearranged schedule, was both orderly and economical.



Downstream view of the dam. Hollow-type non-overpour section at the right.

Power Transport and Delivery —Express and Local Service

During the past few years the Company has been carrying forward an extensive construction program in connection with its transmission and distribution net work, to make available to its customers the power which it has been developing on the Pit River and the streams of the Sierra to the south.

Most recently may be recorded the completion of the Contra Costa Substation near Antioch and the construction of several metropolitan substations about San Francisco bay. New tendencies are also to be noted in the utilization of automatic substations in both the San Francisco and the East Bay territories as well as activities pointing to a general enlargement of the capacities of practically all of the existing stations. Readers of PACIFIC SERVICE MAGAZINE have been made acquainted with the salient features of this program from time to time.

Much has been written of the more or less spectacular hydro-electric generating stations in the mountains, surrounded as they are by the romance of great dams with their lake-like reservoirs and the harnessing of water falls. Something, too, is known of the distributing substations in the centers of population, if only from our observation of them as we go about our daily tasks. The connecting link between the two, the broad network of transmission and distribution lines, receives comparatively little general consideration and is still less understood. How the energy contrives to get from the mountain generators to our factories and farms to turn our machinery and to our towns and cities to light and heat our homes remains much of a popular mystery.

This may be explained, in part, by the fact that it is difficult to visualize a transmission line 100 or 200 miles in length. We see a tower or two, or a few poles, in traveling the highways, but where the line begins or ends is too remote to arouse interest. Another possible reason for this lack of general understanding lies in the rapid strides which have been and are being taken in the technical development of the arts of transmission and distribution. In 1891 there came into existence the first transmission in California, consisting of a pigmy line a few miles in length near Pomona and carrying 10,000 volts. In 1923 we find this Company's main lines from the Pit River plants to the Vaca-Dixon Substation transmitting



In the storm country. Steel tower on the Pit River transmission line.

at 220,000 volts, a distance of 202 miles. All this progress has come to pass in thirty-two years. In fact, it is only during the past ten years that the present type of closely co-ordinated transmission and distribution network has been operated.

The fullest conception of a transmission and distribution system such as that of the Pacific Gas and Electric Company may be most readily gained perhaps by tracing the general routing of the hydro-electric energy from its sources in the Sierra to its points of utilization in the valleys below.

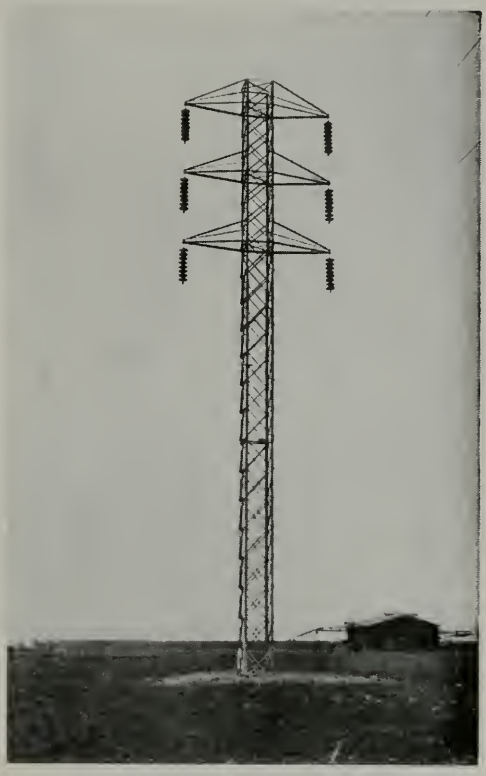
When the Pit River water turns the wheels in the Pit No. 1 plant, the generators are of an installed capacity sufficient to produce 70,000 kilowatts of electric energy at a pressure of 11,000 volts. After being passed through the main transformers at the generating station, this block of power is fed into the main transmission lines at 220,000 volts. The Pit No. 3 plant, similarly, is equipped to contribute a block of 81,000 kilowatts, which with the 25,000 kilowatts from the two Hat Creek plants is sent out over the Pit transmission lines headed toward the major load centers to the south.

From the seven plants of the Drum System comes an available block of 74,750 kilowatts over the Drum and Wise lines, also pointed for the metropolitan load centers about the bay. From the southern end of the Company's territory the Sierra System along the Stanislaus River is equipped to contribute 43,000 kilowatts at 104,000 volts. The Northern California System, the De Sabla System, Colgate, Electra and other scattered plants can furnish 98,000 kilowatts more, making a grand total of 391,750 kilowatts which might be sent out if all the machines were generating at their full capacity at the same time.

The effective disposal of this huge block of power to the customer when and where he needs it, constitutes the Company's principal transmission and distribution problem.

Were such a network to be planned and constructed in its entirety in a virgin territory, the task would be sufficiently complicated to call for the highest technical skill. The difficulties are further increased by the fact that the system is under constant expansion to adapt it to increasing demands in all districts, and to extensions of service into new territory, as well as to new generating stations as they are constructed. All of this must be accomplished piece-meal, building into the existing network, without disturbing its balance or interfering with its successful operation. Not only must the output of the present plants be economically and effectively handled, but consideration must be given in advance to the disposal of the power from such future plants as are scheduled for construction at later dates. It is frequently found economical, for instance, to construct a transmission line with reserve capacity to care for projected plants. Without careful planning, step by step, with the growth of generating facilities and the expansion of the customers' demands, the transmission and distribution network would soon become a hopeless tangle.

A striking metaphor could be drawn about this situation, in which the transmissions main high-voltage would become the express lines of an electric transportation system, tying in with a more numerous network of local lines at certain transfer

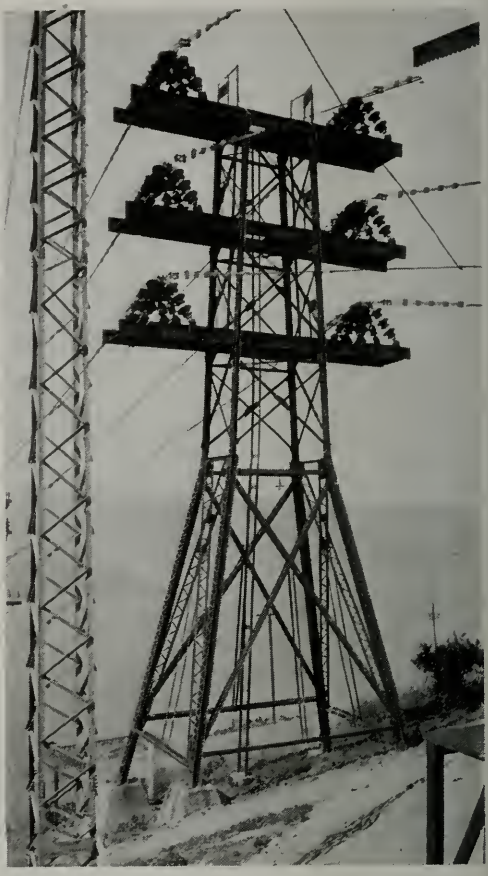


Serving the industrial area. Steel pole on the 110,000-volt line from Claremont to San Leandro.

points. The local lines after transporting their consignments to the local stations, in turn discharge into lesser distribution lines, representing the trucks and wagons of a retail delivery system.

Following the transportation simile further, it may be observed that passengers are assigned to express or local trains primarily in accordance with their destinations and the distances which they are to travel. The Twentieth Century Limited will not stop to discharge one passenger at a flag station, but requires him to dismount at the nearest express stop and to proceed to his destination by way of a local train. Much the same holds true of blocks of electric power. The huge power output from the Pit River developments, from Drum, Stanislaus, Electra and the several lesser plants is stepped up to high voltage for transmission to the larger load centers, under express right-of-way. It would be impossible economically and most difficult technically to interrupt the flow of the heavy high-voltage currents rushing toward the metropolitan area about the bay, to take off a small quantity for some domestic customer along the route. These high-voltage express lines have the sole responsibility of transporting the large blocks of power to points as close to the load centers as feasible and are never interrupted in the performance of this duty.

The Company operates 1554 miles of these express line circuits, ranging between 220,000 volts and 104,000 volts. The terminus of each of these express lines is marked by one of the major transmission substations, such as Vaca-Dixon, Contra Costa, Claremont, Station "J" in Oakland, Newark, and Station "H" in San Francisco. By means of extensive switching and transforming equipment at these points the voltage on the express lines is reduced to that which is suitable for use on the so-called local lines. Thus, the Vaca-Dixon Substation is the end of the 220,000-volt transmission. There the current is stepped down to 110,000 volts and transmitted to the Contra Costa, Claremont Substation and Station "J" on the East Bay side, and to Newark and Station "H" on the San Francisco side of the bay. There is thus formed a huge 110,000-volt ring around the bay from Antioch to San Francisco, surounding the entire industrial, mercantile and residential



South tower on the hill above Port Costa, Carquinez Straits cable crossing.

area from which these five express substations may serve their abundance of energy to all who may require it.

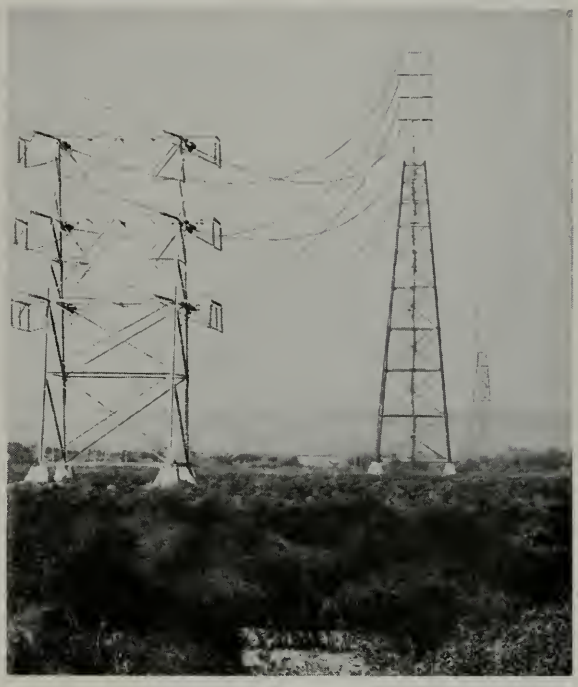
Of course, were there a very large delegation of passengers to be put down at a relatively unimportant point between two main express stops, any but the most limited express trains would find it economical to make an extra stop to accommodate them. So it is with the 60,000 volt semi-express lines. There is occasionally found a large industry, such as a cement mill, a steel mill, a lumber plant or a mine, the power demand from which is sufficiently large to justify a tap from these semi-express lines, with a step-down transformer substation. Nearly all of the minor cities and larger towns in the areas to the north, the east and the south of San Francisco bay are likewise fed from the 60,000-volt lines.

Next in importance below the 60,000-volt

semi-express lines are the 30,000-, 22,000-, and 20,000-volt local lines. The bulk of the industrial load is served from these, as well as the smaller towns and larger rural communities.

Like the railroad prototype, the numbers and positions of these local lines are dependent upon the traffic to be carried. As the power demand in a district grows with the establishment of new industries and the building of new homes, additional local lines are thrown out from the express substations to meet the requirement. This implies that the growth of load must be carefully and continuously watched in all territories, in order that abnormal tendencies toward expansion may be detected as early as possible and the future requirements anticipated before the load approaches critical proportions.

The power company is constantly making line extensions into relatively lean districts, where the future load promises development to justify the construction expense in a reasonable term of years. This, too, follows the railroad parallel, since transportation companies likewise study their passenger and freight density diagrams and provide rail extensions and additional train services into newly developing country to encourage further development and the increase in business which must follow.



The Sacramento River crossing on the Vaca-Dixon-Antioch line. The middle tower is on Sherman Island, 459 feet in height.

There are distribution substations located along and at the end of each of these local lines. While these are smaller and simpler than the transmission substations, they are none the less important in the transportation system, since their failure properly to function would jeopardize the service in the territories which they control.



Industrial substation tapping the 60,000-volt line from South tower to Antioch. (Columbia Steel Company, Pittsburg.)

As a typical city distribution substation, Station "I," San Francisco, might be cited. Its power comes to it from the Pit River, through the Vaca-Dixon Contra Costa, Newark, and Station "H," San Francisco, express substations, at the

latter of which it is stepped down to 11,000 volts and routed to Station "I" for further reduction in voltage and for distribution to the contiguous area. At present the Company operates 250 such substations, urban, suburban, industrial and rural of all descriptions, connected to some 2300 miles of local circuits.

Everything below 20,000 volts is to be considered in the delivery wagon class of lines. These branch out in every direction from the local distribution substations, carrying the bulk of the retail delivery to our offices, stores, street lights and homes. The more important of these are at a pressure of 11,000 volts, although the majority in point of number is at 4,000 volts. In large cities many of these delivery circuits are underground, carried by large cables in tiers of ducts in the streets, to which access is had through manholes. Whenever a traffic barrier is seen about an open manhole, it is an indication to the passer-by on the surface that work is being done on these subterranean delivery lines.

As with the local lines, the load density, or, as it is termed, the average power consumption per square mile, governs the position of these delivery circuits. A load density of from 3,000 to 5,000 kilowatts per square mile might be found, for instance, in a rather closely built city district, while in the most concentrated area in down-town San Francisco the density runs as high as 10,000 kilowatts per square mile. This means correspondingly more retail delivery lines.

Thus far the discussion has covered the output from mountain hydro-electric plants, but the steam-electric plants located in the large metropolitan areas have not been brought into the picture. These may be likened to the special provision made by the railroad transportation company for the handling of its urban and suburban commuting traffic. The city steam plants serve a two-fold function in supplementing the mountain hydro plants at times of peak load and in safeguarding the delivery of power to points where interruptions would be particularly serious. In addition to standing by for emergencies, the four steam plants located in San Francisco, Oakland and Sacramento, in the course of a year, generate a very sizable block of power for delivery into the local systems at 11,000 volts. This is mingled with power from other sources and sent out through the local substations into the delivery lines.

There is one difference worthy of note between the railroad transportation system and our electric transportation network and that is the uncontrolled demand element. Every customer on the delivery lines of an electric transportation system is privileged to turn the switch in his house or his place of business at any hour of the day or night and instantly to receive the power which he wishes.



Martin substation, South San Francisco, where the high-tension lines running up the peninsula from Newark, via Alviso, end their journey.

Automatic Type a Striking Feature of Electric Substation Development

The necessity of providing facilities in the way of transmission and distribution to take care of additional power poured into the "Pacific Service" pool from the Pit River and elsewhere was called to the attention of our readers in the preceding article. In this connection our Company has been engaged for two years past in a general reconstruction program in the course of which several modern distributing substations have been added to the system.

The April, 1925, issue of PACIFIC SERVICE MAGAZINE detailed major features of the reconstruction work done in the Bay counties.

During the past year the work was continued. Equipment to supply increasing demands for power was installed in nineteen substations in the Bay region and three new substations were placed in operation. Reconstruction work was carried throughout the remainder of the territory, additions being made to eleven distributing substations, while new substations have been completed at Olema, Orinda, Redwood City and San Mateo and one is nearing completion at San Jose to be known as Station "B."

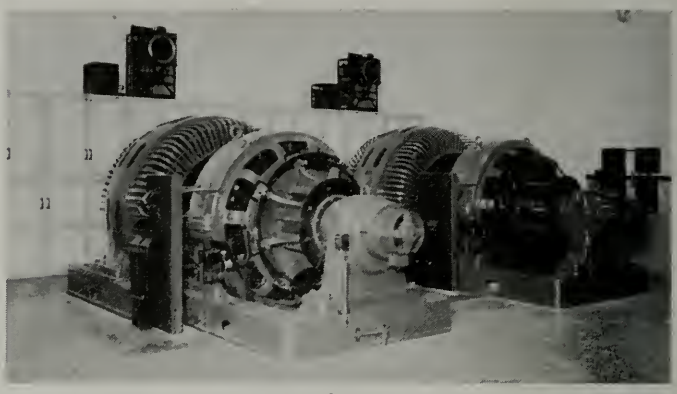
An unusually interesting feature of substation construction work directs attention this year to the Oakland side of San Francisco Bay. The new distributing substations placed in operation in 1926 were Station "I" at Elmhurst, Station "E" at Piedmont and Station "O" at Hayward. The two latter are of particular interest in that they present the newest type of service substation designed in the interest of economy as well as efficiency of operation, namely, the automatic type. Substation "E" will be taken for purpose of illustration. This substation operates without the necessity of the presence of a single human operator. Practically everything that an operator used to do manually in a substation is now accomplished by an operator at a distant station, in this case Station "L," Oakland, by means of electrical impulses carried over the four control wires which connect the two stations. Station "E," technically speaking, is operated by a combination of full automatic and supervisory control apparatus, thus combining two of the most modern developments in electrical substation design at the same plant. Both types of equipment operate without attendants, the supervisory equipment operating, as the name would indicate, under the supervision of an operator at the distant station, while the full automatic equipment operates without even being supervised from any point.

The load carried by Station "E" is of two kinds, alternating current which is supplied



Station "E," Piedmont, a truly representative modern electric substation.

to residential territory and street lighting for general street illumination, and direct current power for the use of the Key System Transit Company. All of our high-voltage transmission lines carry alternating current, and it is necessary only to reduce the voltage to make it suitable to operate electric lights, toasters, and washing machines. The motors which drive the Key Route interurban trains, however, are not designed to operate on alternating current, so it is necessary to change the power from alternating to direct current before it can be used by them. This is done at Station "E," Piedmont, by means of two motor-generator sets, each of which is essentially a large alternating current, synchronous motor, which is coupled to and drives a large generator which produces direct current. Thus, the current goes in as alternating and comes out as direct current of a voltage suitable to drive the motors on the Key trains. The amount of power which must be furnished to the Key Route is not constant, but varies throughout the day. During the rush hours, eight- and ten-car trains are operated and these have an exceedingly heavy demand for instantaneous power for starting purposes. At other times, however, the load is comparatively light, so that of the two machines at Station "E" that supply power for the railway, it is only necessary to operate one continuously, the other being held in reserve for periods of excessive load.



Motor generator sets for street railway service.



Supervisory control panel at Station "L," Oakland, controlling the operation of Station "E," Piedmont, some two miles distant.

The operation of these machines is practically full automatic, the only operations which are normally controlled by an operator being those of starting and stopping. The reason for having the starting and stopping of these machines controlled by the operator is that he can tell very accurately when the extra machine will be needed and can have it started up and running, ready to assume its share of the load, whereas if the machine had to be started up by the automatic equipment each time it was called upon to supply power, not only would the length of time necessary to start it up and get it ready to supply the power delay the trains but, also, the machine itself would be continually starting and stopping. In designing the plant, therefore, it was decided that the machines should be started and stopped from Station "L," but that they should be controlled by the automatic equipment while running.

We have heard much of automatic electrical equipment, of automatic water heaters where the temperature of the water dropping below a certain point automatically causes the heat to be turned on and, rising to another point, causes the heat to be turned off; of automatic elevators where the pressing of a certain button causes the car to go to a certain floor and stop, not to be moved again until another button is pressed. Let us look for a few minutes into the interior of this automatic electric substation to see what makes it possible for it to operate with so little human aid.

During the early morning hours there is comparatively little traffic on the Key line, so the trains are of single cars only and lightly loaded, thus requiring a relatively small amount of power. It is therefore not necessary to operate all of the railway motor-generators in all eight of the Pacific Gas and Electric Company substations which serve the Key System Lines. Let us assume, then, that at this time one of the two machines at Station "E" is furnishing all of the power supplied by that station.

The time approaches when some 30,000 commuters must be moved across the bay to their work. The operator at Station "L," being informed by the telemeter, a very delicate electrical device similar to the ordinary electrical meter, of the exact amount of power being furnished by the one machine in Station "E" which is running, notices that the amount of power supplied is increasing. He, therefore, decides to start the second machine and thus provide sufficient power to meet the increasing load. He steps to the supervisory control panel, turns the key switch controlling motor generator set No. 2, then turns the master key switch at the bottom of the control panel, and within 45 seconds a red light flashes on, telling him that the machine is running and ready to furnish its share of the load.

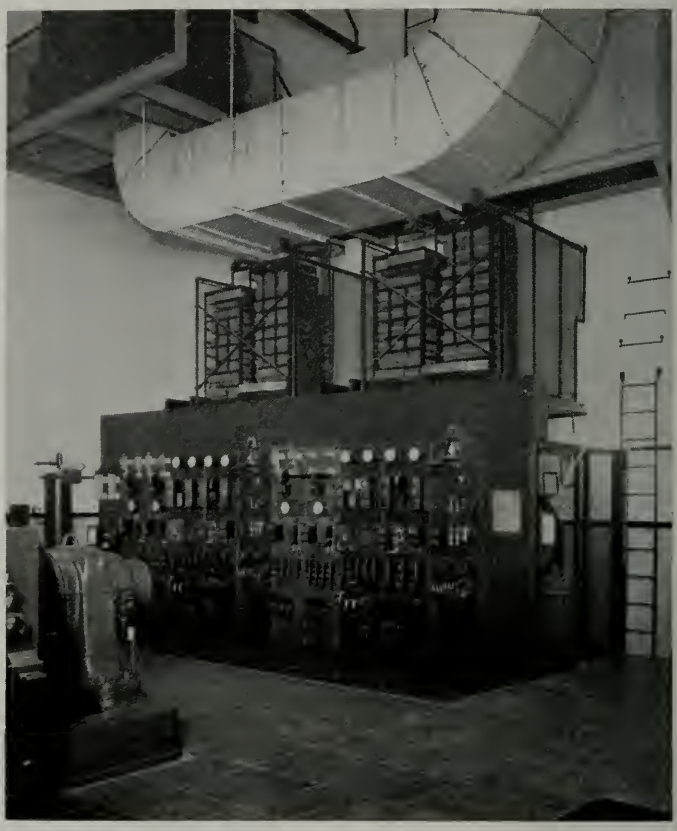
A picture of the supervisory control panel is shown here. Each key on the panel controls a feeder switch or the main switch for a piece of apparatus, except the master key at the lower right hand corner, which transmits the motivating power impulse when it is desired to change the status of a piece of the controlled equipment. The key to the left of the master controls the alarm gong, which rings an alarm when a machine is shut down or a feeder switch opened by a protective device. Near each of the other keys are three lights, white, green and red in color. One of these three lights is lighted at all times, indicating the condition of the apparatus in the distant station. The green light indicates that the switch is open; the red light indicates that it is closed; while a white light flashing up indicates that something is wrong, usually that the last direction has not been followed and that another attempt should be made to accomplish the desired object.

To start the motor-generator, the operator first assures himself that the green light is burning, which means that the apparatus is in condition to be started. He turns the key



Feeder switchboard at Station "E," for local distributive purposes.

marked "Motor Generator Set No. 2" to the "On" position and closes the master switch to apply the necessary current. This action closes a switch which causes various electrical circuits to be completed, many coils to be energized, until the great motor and generator are rotating at the required speed and are automatically connected to the outgoing line. Almost immediately, within three-quarters of a minute, in fact, the red light flashes on, indicating that the switch is closed and that the machine is running and ready to supply power.



Motor generator automatic switchboard and supervisory controlled railway feeder at Station "E," Piedmont.

We have seen how the machine is started in anticipation of a load, how it automatically carries enough to supply the power necessary to move the interurban trains. Suppose now that a trolley wire has fallen and the line has become short-circuited, or grounded, and that the machine is in danger of burning out. On the occurrence of the short circuit, the current flow increases rapidly to an excessive amount. For an instant this excessive current does not prove dangerous, as frequently when two or more large trains start at the same time the instantaneous current is excessive, but should it continue for more than a fraction of a minute the apparatus would be damaged. To prevent this, an electric relay opens the switches connecting the machine to the line and thus protects it from destruction. After a few seconds to allow the short circuit to clear itself, if possible, the switch is automatically thrown in again, "feeling out" to determine if it can be closed with safety. If the line is clear, the switch will stay in and the operation will continue as before. However, should the line still be short-circuited the switch will "feel out" again and again, continuing this process until the line is clear and the switch remains closed.

In addition to being protected against short-circuits and grounds on the lines, the motor-generator sets are automatically protected against many other classes of accidents. Should the voltage on the line furnishing alternating current power to the station drop below a certain point, thus tending to make the machines inoperative, the machines are automatically shut down, but may be started again when the voltage rises to the proper amount. Each time a switch is opened or a machine is shut down by the automatic equipment the bell alarm sounds in Station "L," thus informing the attendant there that the operation at Station "E" is not normal.

Should the bearings on a machine get too hot and be in danger of burning out, a thermal relay shuts the machine down and does not permit starting again until some-

one has visited the station and reset a lock on the relay. This is because a heated bearing usually means that the bearing is at fault and should be repaired before the machine is operated further. Should the windings of a machine become overheated, a fairly common occurrence under heavy continuous loads, the machine is shut down by another thermal relay, but in this case, as soon as the windings have cooled sufficiently, the machine may be started up again.

The protective equipment also includes a device to shut the machine down should an excessive speed be reached, as well as various other electrical protective safety devices too complicated to be understood by any but a skilled technician.

Now suppose that the morning traffic rush is over. The operator is informed by the telemeter on the switchboard that the load on the machines is not great enough to justify the continued operation of both machines. He promptly turns the key for motor generator set No. 2 to the "Off" position and then turns the master key transmitting the impulse which opens a switch shutting down the machine. The machine then automatically disconnects itself from the outgoing line.

We have seen how the automatic equipment works when used on a railway feeder circuit. How then does it operate when connected to a feeder such as the one that serves our homes with light and power, or that furnishes electricity for the illumination of our streets?

The supplying of power here is simpler because it is not necessary to change the electricity from alternating current to direct current. For this kind of service the voltage is changed from 11,000 to 4,150 volts or 2,300 volts according to its intended use, in large transformers at the station, after which it is sent out to the various districts on feeders which carry current at the reduced voltages. The electricity on the 4,150-volt feeders is again reduced to 110 and 220 volts by means of smaller distribution transformers, which are located either on poles or in manholes near the homes which are to be supplied with current, while the electricity on the 2,300-volt feeders is again reduced to make it suitable for street illumination.

There is a switch on each of the 11,000-volt feeders entering Station "E," as well as a switch on each of the feeders leaving the station. These switches are closed practically all of the time. The control devices are therefore used mainly to close switches after they have been automatically opened by an overload, a short circuit or a ground. If the circuit has been automatically thrown out in Station "E," an alarm is instantly sounded in Station "L," calling the operator's attention to the switchboard. Since the green light is burning, he knows that the switch is open. Upon waiting a few seconds to give the trouble an opportunity to right itself (if it is a short circuit it might burn itself out and thus leave the line clear), he turns the keys necessary to close the switch. If the red light comes on and stays, he knows that the switch has been successfully closed and that the difficulty has been righted. If the green light comes on, he is told that the mechanism refuses to stay closed and that he must send someone to right the trouble on the line.

In addition to the equipment already mentioned, the operator at Station "L" has control through the supervisory control panel of various other pieces of mechanical apparatus in Station "E." Two keys, with indicating lamps, control the two blowers which force air into the station to cool the equipment, while two other keys control the two exhausters which draw air out of the station to completing the ventilating cycle.

Two sets of lamps, both without keys and with only two lights each, show the status of two battery charging sets which operate automatically, one for the supervisory control battery, one for the station battery, indicating whether they are running or not. Still another set of two lamps indicates when the station door has been opened or closed. This single device is of great convenience to the supervisory operator at Station "L," since it informs him of the presence of some one at Station "E" with whom he may communicate by telephone.

From this sketch it may be seen that although no operator is present at one of these modern automatically and supervisorily controlled substations, the operator at the supervising station has enough indications from the controlled stations to enable him to keep it in operation almost continuously. The automatic apparatus needs but little attention, two inspections a week, on an average, being found sufficient.

Doubling Gas Storage Capacity in East Bay to Meet Conditions

Extensive building activities in the East Bay cities during the last seven years have added a large number of new gas consumers to our company's system in that territory. The resultant increased demand for gas service has been taken care of, from time to time, by adding to the equipment of the central generating plant known as Station "B," located at First and Market Streets, Oakland.

During this period three new generators, two holders, eight compressors, eight boilers and many other pieces of equipment necessary for gas generation and distribution were added to the plant. The generators are of the two-shell type, 18 feet 9 inches in diameter, and each has a capacity of 5,000,000 cubic feet daily output. The first generator was placed in operation October 21, 1921, the second on April 24, 1925, and the third on December 18, 1925. Of the two new holders, one of 6,000,000 cubic feet capacity and of the water seal type, was erected at the central generating plant and placed in operation September 28, 1922; the other holder was erected at San Leandro, having a capacity of 500,000 cubic feet, and was placed in operation on February 28, 1922. The compressors at the main plant have a capacity of 2,750,000 cubic feet per hour. The boilers have a rating of 4,800 horsepower.

With all these additions, however, the plant was still lacking in capacity to meet the anticipated peak day sendout. It was well equipped with generators to meet the demand, but was lacking in holder storage capacity. So, to meet the situation a 10,000,000 cubic foot storage holder was decided upon. After careful survey of available location an eight-acre tract of land was purchased at the foot of 50th Avenue in East Oakland, in the factory area near San Francisco bay. This site was selected because it was near the center of distribution for East Oakland, and, also, for the reason



The 10,000,000-cubic foot gas holder of the new waterless type, recently erected at East Oakland.

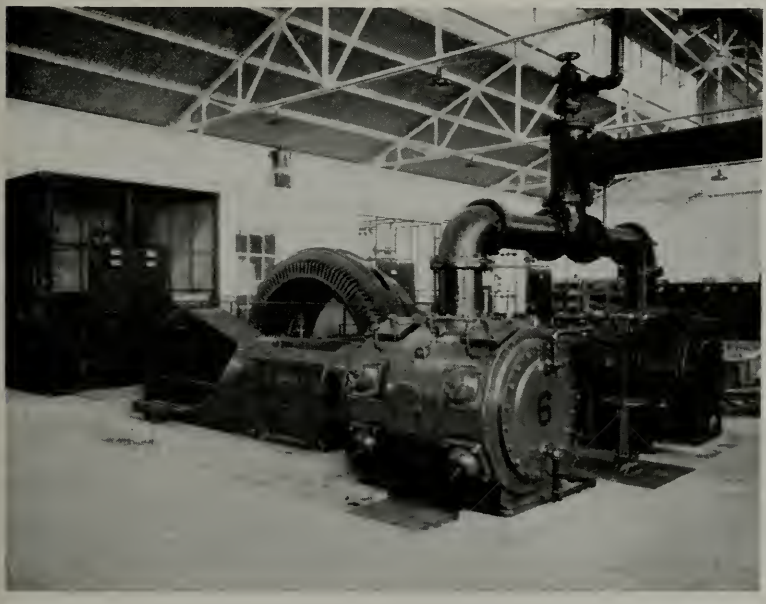
that the formation of the ground was such that, after test holes had been bored and test loads applied at various points, the simplest design of foundation was all that was required.



General view of the compressor station, showing both reciprocating and centrifugal types of compressors.

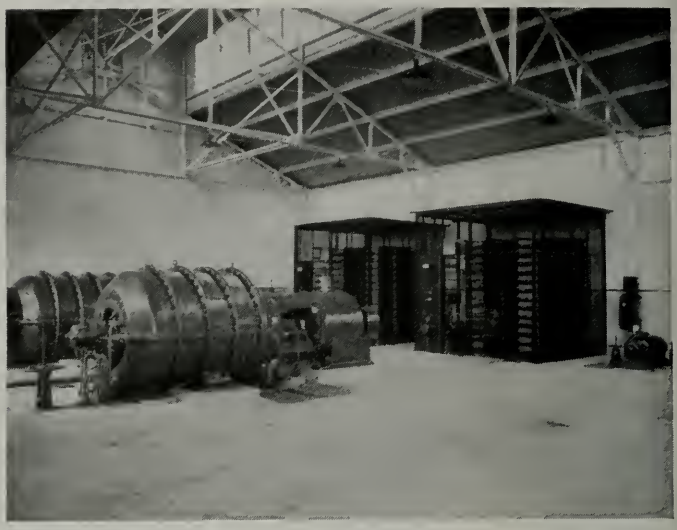
A radical departure from former construction was made when it was decided to build a holder of the new type known as waterless. This differs from the water seal telescopic type previously installed by our company in that in the latter the lower tank is filled with water to make a seal between the gas and the surrounding atmosphere, whereas in the new type a movable piston is used, requiring 52,000 gallons of tar as a sealing medium. The holder when filled with gas will throw six inches of pressure water column. Under these conditions it was designed to withstand a wind velocity of 100 miles an hour, the roof to carry a total live and dead load of 40 lbs. per sq. ft.

The contract was awarded to the Bartlett-Hayward Company of Baltimore, Maryland, on December 21, 1925. Excavation for the cut-off wall of the foundation was started on the same day. The trench had a depth of ten feet and a width of nine feet on a diameter of 218 feet. A trenching machine was used for excavation and rapid progress was made. A total of 2,000 cubic yards was excavated, and the cut-off trench was completed January 3, 1926. The excavated material was used for raising the ground level so



View of reciprocating compressor, the electrical substation attached.

that the holder would be above floods, which sometimes occur in this low, flat territory. Forms were then set and concrete poured for the cut-off wall. This wall is "T" shaped and has an 8-foot spread at the bottom, with a center core of 3 feet. This connects with an 18-inch foundation slab that extends six feet in from the outside diameter of the holder foundation and tapers to 6 inches in thickness for the remainder of the slab. Practically no load is on the bottom slab, except the weight of the bottom plates and the pressure created by the pressure of the gas, which makes this thin slab possible. Two 36-inch inlet and outlet pipes and valves were set in the foundation before the concrete was poured.



Centrifugal compressors, connected to individual electrical substations.

The foundation, containing 2,150 cubic yards of concrete, was finished March 2, 1926. On account of favorable conditions the foundation was completed ahead of schedule.

The first steel for the holder did not arrive until March 30, 1926. This wait of four weeks was the only delay on the job. The bottom of the holder was then assembled, riveted and lowered on the foundation on April 28. This riveted steel bottom was put together on 18-inch blocks, resting on the concrete foundation. Military precision of movement marked the lowering of the bottom to the foundation. One hundred and forty-two men stood at as many jacks. In the center was the foreman with a gong in his hand. He struck the gong once and each of the 142 men made a single turn. This kept up for half an hour. At the finish, the gong had sounded 120 times and the bottom was resting snugly on the two-inch bed of sand used to give an even bearing between the bottom and the concrete foundation. Next, the piston and roof were assembled while resting on the bottom, temporarily fastened together and raised as a unit by air pressure as the side courses were erected. Finally, when the top was reached, the roof section was attached to the supporting columns and the piston disconnected. The piston was used as a working platform inside of the holder. The working scaffolding on the outside had three levels from which the workmen carried out their various operations. These scaffolds were hung from the roof and were carried up as the piston



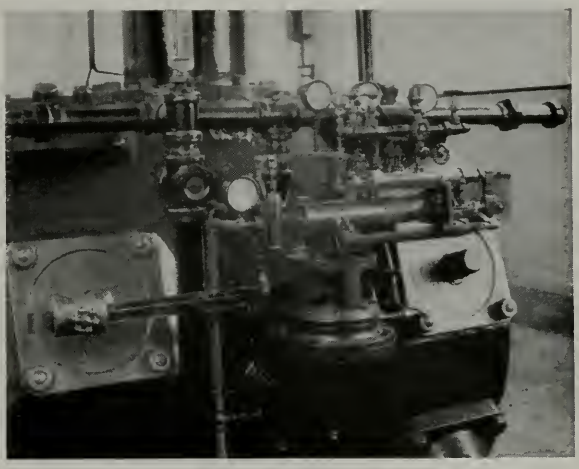
Exterior view of the compressor building, 144 feet long by 50 feet wide.

was raised with air. Galleries were also built around the holder at various levels to give access to the outside of the completed holder. The holder is constructed of steel plate throughout, with steel beams and angles for stiffening. The bottom plates are $\frac{5}{32}$ of an inch and $\frac{9}{64}$ of an inch in thickness. The horizontal courses are of steel plate $32\frac{1}{2}$ inches wide and are flanged out so as to form stiffening ribs for the completed shell. The lower course is $\frac{3}{16}$ of an inch steel and the remainder $\frac{11}{64}$ of an inch, and is riveted throughout. The circumference is divided into 24 sides, polygon in shape, supported by 24 vertical corner posts, extending from the bottom to the top of the holder. Each corner post is anchored with two 4-inch bolts, 10 feet long.

The piston is constructed of 24 rigidly connected radial trusses, braced to withstand all possible strains. The piston plating, $\frac{11}{64}$ of an inch thick, is supported by these trusses and will safely withstand the gas pressure. The outer edge of the piston, opposite each of the 24 vertical corner posts of the holder shell, has two sets of radial guide rollers, or 48 rollers in all, to guide the piston and keep it in proper position after it is once adjusted. There is also a pair of brass rubbing strips installed at four of the vertical corner posts to prevent a horizontal or spiral movement of the piston.



Cooling tower, where water for the compressors is cooled and recirculated.



Automatic unloader for reciprocating compressor.

The tar seal, or cup, is constructed of bent plates, securely attached to the outer edge of the piston and extending around the entire circumference. The cup is lined at the bottom with canvas extending from a point on the inner wall of the cup along the bottom and upward about six inches. The upper end is attached to a steel rubbing bar that bears against the holder shell. The rubbing bar that is attached to the canvas is supported by carrying arms, supplied with levers and counterweights, which hold the rubbing bars against the shell.

Near the outer edge of the foundation, six steel sumps are placed to receive the tar collected at the bottom of the holder. The tar overflows into the sumps through pipes in the lower shell course. The sumps are fitted with floats, connected to electric driven tar pumps of the automatic type. When the tar within the holder reaches the predetermined level, the float, through a series of levers, starts the pump which pumps the tar to the tar distributors near the top of the holder. The original tar is thus kept in circulation.

At intervals around the holder, slightly below the top, are slots connected with pipes running above the level of the roof. When the rubbing bars on the outer edge of the piston pass these slots the gas will blow out through them, so that they act as safety valves to prevent the piston rising high enough to damage itself on the roof.

On the outside of the holder, in one of the panels formed by two corner posts, a set of stairs is installed, giving access to the

top of the holder, as well as to the galleries. In order to reach the piston, an electrically operated 4-passenger elevator cage has been installed within the holder and permits easy, quick and safe access to the piston. The motor for driving the cables for the elevator is installed in a steel house on the roof.



Lowering the bottom of the new holder into position.

It is necessary to keep in touch at all times with the man who has charge of the operation of the holder and a special system of telephones has been arranged. Three telephones were necessary to give a perfect system and these were installed at various points, the first being in the compressor room, the second on the roof of the holder, and the third on the piston, this being made possible by a special arrangement of pulleys. With this telephone system, the operator in the compressor station can keep in touch at all times with the man in charge of the holder.

The new holder has a height of 301 feet and a diameter of 218 feet, and contains 2,800 tons of steel. Near the top of the holder is painted the sign: "P. G. & E. Fuel Bin for East Bay Cities." This lettering occupies 6 of the 24 bays, the lettering being from 8 to 16 feet in height, and occupying a space on the side of the holder of about 80 feet in width and 168 feet in length. The job was completed November 10th last, 10 months and 21 days from the date of the signing of the contract.

In addition to the holder the general plan provided for the construction of a compressor station equipped with five compressors, two of the centrifugal type and three of the piston type. The two centrifugal compressors are directly connected to variable speed motors having each a capacity of 500,000 cubic feet per hour. These compressors have a range in pressure of from two to nine pounds, which is made possible by a speed variation of 900 to 3,500 revolutions per minute. In order to control the volume, an automatic butterfly valve was installed in the suction of each compressor. The control of the pressure and volume results in a large power saving.

The three piston type compressors are directly connected to synchronous motors and are of the automatic suction unloading type and can be operated on pressures ranging from 8 to 50 pounds. The pressures on these lines are controlled by 3 three-quarter inch needle valves located at the operator's office alongside of the gauges. The automatic unloader cuts off the supply of gas from the compressor, when the predetermined pressure is reached, and automatically cuts in again when the pressure drops below the pressure set for. Under this arrangement a power saving is possible.

Each compressor is connected to an individual electrical substation, which insures continuous service at all times. There are nine truck-type switches of the latest design. Two of these are for incoming power, one bus-tie—so that one-half of the station can be isolated in case of trouble on one feeder—one for the transformer bank and one for each of the five compressors. The new compressor plant is housed in a struc-

tural steel frame building fifty feet wide and 144 feet long, with brick walls and corrugated iron roof, the roof of the monitor type with special pivoted windows for ventilation and illuminating the interior of the building. Special pivoted windows are arranged under the eaves of the roof and extend completely around the sides and ends of the building and are used for ventilation and general illumination. This arrangement gives a well-lighted and fireproof building.

The compressor station is equipped with a gas-engine-driven lighting unit, which operates on manufactured gas and is used for general illumination at night should power service be interrupted. A cooling tower is used to cool the water necessary for the compressors, this water being re-circulated by a centrifugal motor driven pump, thereby greatly reducing the amount of water necessary to be supplied.

This compressor station is a one-man plant, each operator working on an 8-hour shift. The operator's office is located in the center of the building along the north wall, where he can watch the target that indicates the amount of gas in the holder. In this office are mounted the gauges that show the pressures on the various lines leading to the distribution system. By the use of these gauges the pressures are controlled over the peak hours, through a 24-inch semi-high pressure line and a 16-inch high pressure line to East Oakland and vicinity, a 12-inch high pressure line to San Leandro and Hayward, and an 8-inch high pressure line to Alameda. The two first-mentioned lines connect with those leading from the generating plant in Oakland and are used for filling the holder during midnight hours and for distributing gas during peak hours.

Gas was turned into the new holder November 10th last. Mr. W. S. Yard, Vice-President in charge of Gas Construction and Operation, assisted by Miss Grace Purcell and Miss Isabelle Foster, both of East Bay Division, opened the thirty-six inch valve which allowed the gas manufactured at First and Market Streets, Oakland, a distance of four and one-half miles, to flow into this mammoth structure, the first of its kind to be installed by this company. The compressor station adjoining the holder was placed in operation at the same time. Those present at the ceremony included officials of the company, engineers and members of the gas department and a delegation from East Bay Division headed by Mr. Lee H. Newbert, Division Manager.

With this new holder and compressor station in operation it is now possible to operate the generators at the central plant on a better load factor. The new holder is filled during the night hours so that gas will be available for distribution in East Oakland between six o'clock in the morning and seven o'clock in the evening. The total storage capacity in the East Bay Division system before this new holder was placed in operation was but 9,214,000 cubic feet, so with the addition of the 10,000,000 cubic foot structure the storage capacity has more than doubled. Its aggregate of 19,214,000 cubic feet is approximately 67 per cent of peak-day sendout in 1926.

The generating capacity of the central plant in 1920 was 16,600,000 cubic feet daily, and in 1926 the generating capacity was 31,700,000 cubic feet daily, an increase of approximately 91 per cent. The plant distributes gas as far north as Giant, a distance of 16 miles, and south to Hayward, a distance of 18 miles from Oakland. During the last seven years the demand for gas in East Bay territory has shown a remarkable growth. For the year 1920 the distribution system, including Oakland, Richmond, Berkeley, Alameda, San Leandro and Hayward, consisted of 1183 miles of gas mains with 89,102 consumers served and the total gas manufactured for the year 3,877,547,000 cubic feet. For the year 1926 the system had 1540 miles of main serving 132,446 consumers, and the total gas manufactured for the year was 6,495,180,000 cubic feet. This shows an increase in gas sold for the seven years of approximately 67.5 per cent. The peak day in 1920 was on December 23d, when 13,530,000 cubic feet of gas was delivered, and on December 24, 1926, the peak day was 28,810,000 cubic feet, or an increase for the seven years of approximately 113 per cent. The increase in demand is attributed in a large measure to the heating and industrial loads.

Revival of Coal as a Gas-Making Fuel in "Pacific Service" Territory

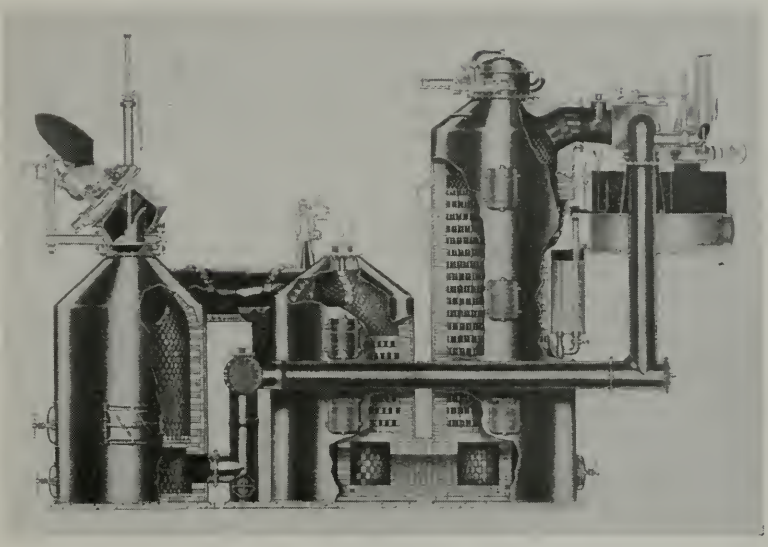
An interesting item on the list of accomplishments by our Company's Department of Gas Construction and Operation during the past year was the revival of coal-gas manufacture. This was undertaken largely by way of experiment, a mingling of old and modern methods, as it were, and the city of Marysville was selected for the experiment. It remains to be said that the experiment, so far, has proved eminently successful.

The gas industry has undergone many changes since Peter Donahue and his associates erected the first illuminating gas plant in San Francisco in 1854. The first gas was made from coal, then for a short period carburetted water gas was the standard, but with the development of the oil fields in California the oil gas process was invented, and has held the field exclusively in this section of the country now for a quarter of a century. Meanwhile, although gas as an illuminating agent has been generally supplanted by electricity, its availability as an industrial fuel has become so recognized and appreciated that this more-than-a-century-old commodity is holding its own to a greater extent than ever.

The city of Marysville, one of the oldest and, during the pioneer mining days, one of the most important towns in California, was the third place in our State to introduce illuminating gas. Encouraged by the success of gas making in San Francisco and Sacramento, in the year 1857 prominent citizens of the pioneer valley town made proposals to the Common Council to furnish Marysville with gas and water, and on May 22, 1858, the Marysville Coal Gas Company was incorporated. Coal gas was sup-



Building erected in 1865 to house the gas company's offices in Marysville. It still stands.



Carburetted water gas set, showing automatic charger and backrun line.

plied and at first iron retorts were used; but in 1861 a set of clay retorts was installed. In 1865 a new plant with a substantial brick building and office was completed on the corner of Second and "B" Streets. This building still stands. Gas manufacturing in those days was just as full of trying conditions as with the more complicated processes today. The log of operation from 1861 to 1866 relates a few of the more serious mishaps. For instance: September 8, 1861—"Cannel Coal all out." This was probably a critical time, as on the next day the County Fair opened. October 23, 1861—"Trouble with purifiers—lost the whole gasometer full of gas — trouble for two days." December 9, 1861, at the time of a great flood, "Height of water one foot over the level of the yard—made no gas for sixteen hours." January 10, 1862: "Height of water so it overflows our center valve and we had to pump for fourteen hours to keep from putting fires out. Water 5⅜ inches higher than on December 9, 1861." October 26, 1864: "9 P. M. Gasometer caught fast and remained; hung until 11:30 P. M.; shut off gas to raise it."

Coal was imported and although it often came in as ballast, the high local freight rates made it expensive. It was bought through sundry dealers in rather small lots and the prices with each lot varied somewhat, but were about as follows: Vancouver, $13.50; Sydney, $15.00; Chile, $15.00; cannel coal from different parts of England, $18.60 to $25.60. Several kinds were kept on hand and used in mixtures, as it was necessary to carbonize a lower grade with a better and more costly coal. The gas yields were up and down. This probably was due to the necessity of changing the mixtures to suit the kinds of coal on hand and also the varying quality of each kind. The average yield for the year ending July 6, 1864, was 3.5 cubic feet of gas per pound of coal, whereas, the following year the average was 4.16 cubic feet per pound. This latter figure includes about four months' operation in the new plant, which was started April 8, 1865.

The purification was accomplished by passing the gas through a layer of lime resting on a perforated plate. The lime cost $25 a ton and about 100 lbs. per 1000 cubic feet of gas was required, making the cost of materials for purification amount to $1.25 a thousand. The labor for handling the lime into and out of the boxes and the disposal of the foul-smelling spent lime must have added several cents a thousand to the purification expenses.

The price charged for the gas was first $12 per thousand cubic feet, but this was reduced to $11 in 1861 and to $10 in 1863. For the year ending July 6, 1864, the lime used was 103 pounds a thousand, the gas yield 7,000 cubic feet per ton, at an average cost of $16.40 per ton. The leakage and condensation loss was 20 per cent and the average daily make about 12,300 cubic feet. There were probably three men employed at the plant at that time, as two benches were not operated until December 24, 1865. The records do not show the sale of any coke. It is possible that all of the coke

was used for firing the benches, which were of the direct fire type.

The consumption of gas gradually increased from 12,300 cubic feet per day in 1865 to 34,000 cubic feet in 1879. From 1886 to 1896 there was a struggle against electric competition, but at the latter date the use of gas as a fuel was beginning and although gas lighting declined, the new uses inspired the industry to more rapid growth. In 1898 a rival company was formed and installed a 60,000 cubic feet per day water gas generator upon a portion of the property at the present gas plant site. The coal gas company was purchased within a few months and within three years the water gas plant was superseded by a 90,000 cubic feet per day Lowe crude oil set, and in five years a 175,000 cubic feet per day Jones set was added. These machines carried the load until 1924, when a 550,000 cubic feet per day straight shot oil gas generator was built and the plant completely remodeled with provisions for future extension at a minimum expense. Then expansion became necessary almost immediately, due to the decision to run a transmission line to Oroville in lieu of rebuilding that plant.

The present additional installations consist of two 9-foot Steere Engineering Company generators, complete with backrun connections, automatic charger, auxiliaries, wash-cooler, cooling coils, tar extractor, multiple washer and tar de-emulsifier. The lampblack separators were converted into a tar separator and tar storage pits. A general view of the plant is given here. The row of six scrubbers extending out from the building was used with the oil gas sets. The oil gas formerly passed through these before entering the relief holder. Now the water gas passes directly to the relief holder and then to the tall washer-cooler shown near the building. The scrubbing water is kept in a closed system passing first down through the tower, cooling the gas from 140 degrees to 68 degrees F., thence through the cooling coils where it is chilled by water flowing over the outside. The cooling water on the outside of the coils is also in a closed circuit consisting of a cooling tower and the coils.

After leaving the washer-cooler, the gas



General view of present day gas plant at Marysville, where our Company has recently installed a coal-gas manufacturing equipment.

travels through the following apparatus in succession: exhausters, tar-extractor, multiple washer, purifiers, meter, storage holder, and compressors or boosters to the high or low pressure mains. The condensation and tar are collected in the tar separator, from which the tar is taken to the de-emulsifier and thence to the tar storage. The condensation is used as process water for generating steam in the superheater during the backrun. The flow sheet of the gas and by-products in this plant is much simpler than for oil gas and there is practically no waste water discharge.



Controls, gauge board and meters which make possible the operation of the entire process from a central position.

Another illustration shows in detail the three shells, generator, carburetor and superheater of the water-gas set, designed for the use of coal as fuel, including the backrun connections and the automatic charger. Each set has a capacity of 80,000 cubic feet per hour. This is in excess of the present requirements, but allowance is made for further extension of transmission lines and probability of using certain low-grade California coals which may reduce the capacity. The fuel used is pea-coal, three-quarter inch by one and five-eighths inches, from Carbon County, Utah.

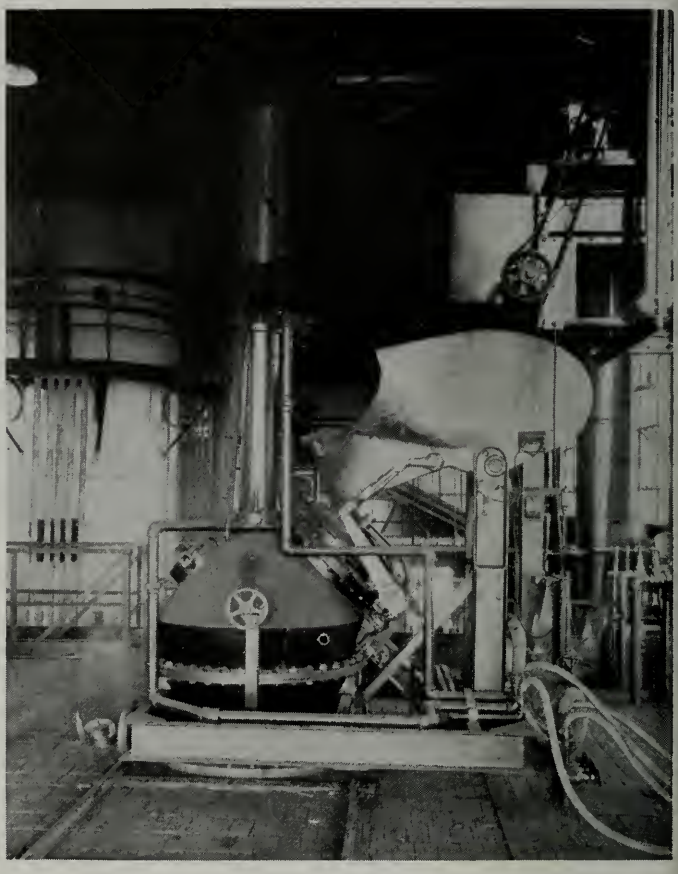
The selection of these materials and this process was made after a thorough study by a representative of the Bureau of Mines under the direction of the California Gas Research Council. The non-coking coal of Utah is very similar to certain eastern coals that have been found most suitable for use in water gas machines, and the modern water-gas plant seemed to suit quite well the requirements imposed by California conditions. It is also possible that some of the California coals may soon prove satisfactory for this purpose, thus providing a guarantee of a future fuel supply more attractive.

The new process is a modification of the original carburetted water-gas system in which only coke or anthracite coal could be used. For many years combination coal and carburetted water-gas plants have been standard in other parts of the United States. The coal was carbonized in the coal-gas plant and the excess coke, that is, the coke not sold, was gasified in water-gas generators. These plants yielded coke, tar and ammonia as by-products, the profitable disposal of which was a necessity. In those localities where the by-product market was not good, but anthracite coal was available, anthracite coal was used as a fuel in carburetted water-gas machines. Thus, this process has become very well standardized.

In California there is no large market for coke and no anthracite coal is available. The abundance of fuel caused the development of the oil-gas process, and that method of manufacture has held sway for the past twenty years. In the meantime, other localities were in such straits that they had neither coke market, anthracite coal nor fuel oil, but low-grade bituminous coal could be had at reasonable prices. As a result, several modified carburetted water-gas processes have been produced and are now fairly well standardized. This places within the reach of the California industries proven methods of gas manufacture to meet any possibility of fuel oil shortage.

Although we do not feel that we have as yet obtained our best operation, we can at this time state that the adoption of this method of gas manufacture in Marysville

has proven satisfactory. The average heating value has been maintained as readily as with oil gas and the service to the consumer is on a par with that previously rendered. The consumers who have been questioned seem to think that if there is any difference in the gas it is better now. The service complaints are normal. There have been no noticeable changes in pressure conditions and no unusual effort has been made to boost the pressure at the Works' outlet. The distribution system in Marysville is 95 per cent low pressure, while in Yuba City and the remaining territory, it is high pressure.



Automatic coal-charging apparatus which weighs, charges and spreads the fuel.

The transmission line to Oroville consists of twenty-six miles of eight-inch and six miles of six-inch pipe. There are 1,150 consumers in Oroville and about 1,500 new consumers will be secured en route. It is probable that within one or two years the transmission line will be extended by adding twenty miles of six-inch pipe from the far end of the present eight-inch section, to Chico, where 2,500 consumers are now being served by a local plant. At present an initial pressure of twenty pounds per square inch at the Marysville end has been sufficient for transmission and distribution; the loss in heating value between Marysville and Oroville is from five to ten B. T. U.

As has been stated, the new plant at Marysville is really experimental and is in line with the general policy of the Pacific Gas and Electric Company to pioneer in the adoption of new processes. It is particularly gratifying that this adventure is successful and has proven the practicability of gas manufacture from coal in California. It is not necessary that the supply of fuel oil become depleted or that the price advance in order to make this change feasible, for it is paying its way in Marysville, now. Like Yuba County's wheat field of 1845 and peach orchard of 1855, it is another trump in the hand to be used when the occasion demands, whether it be five, ten or twenty years hence. At present, the work comprises education, standardization of operation, improvement in the method for removal of clinkers and further recovery of waste heat. These tasks are not as difficult as they might appear, for such great advances have been made in all of them in the Eastern States within the past few years that the oil gas man of California need not worry about the future fuel oil supply.

Interesting Problems Involved in Research and Experiment

In addition to regular construction and operation work, the Gas Department has conducted a program of research and investigation into a chain of problems which are involved in the constant endeavor to improve standards of service. Many of these problems are due to improvements in mechanical equipment and new knowledge made available by the chemical and physical sciences.

Since the gas industry is primarily a chemical industry, advance in its processes must follow that rapidly growing science. "Pacific Service" is on the alert for any new processes of manufacturing gas which can be applied economically to its territory, and the Gas Department has carried on numerous experiments for the improvement of the oil-gas process which it is using at present in fifty-five generators distributed over the system and having a daily aggregate capacity of 112,000,000 cubic feet. These experiments have resulted in improved practices which, to a certain extent, have counteracted the increased costs of gas production. As a matter of fact, during the past year the company has been able to sell gas to its consumers on a rate basis established by the State Railroad Commission in 1920 when labor and material costs were lower.

The problem of pipe corrosion has been studied for several years and our engineers, in conjunction with the California Gas Research Council and certain commercial companies, have reached a solution in the use of a satisfactory protective wrapping and a machine for applying the wrapping mechanically. The result of this research work has materially reduced the amount of cast-iron pipe used for gas distribution through transmission mains.

Another of the problems facing the gas men today is the dehydration of gas or, at least, the elimination of the excess water vapors carried along with the gas which later condenses in the mains, causing inconvenience to consumers. The dehydration of gas under pressures from 50 to 100 pounds has been fairly well taken care of by the installation of tubular aftercoolers located upon the discharge from the compressors. The gas which has been heated during compression is passed through a multitude of metal tubes of very small diameter around which the cold water is circulating. This results in condensation of the water vapor and, also, some of the light oils and benzol. Plants of this character have been installed at the Potrero Plant, in San Francisco; Station "B," in Oakland, and Fresno. The light oils and benzol collected from the Oakland plant are shipped by tank car to the Potrero Plant, where a small benzol refinery has been installed. Here the crude benzol is refined into commercial products known as 90 per cent benzol and 95 per cent benzol. These products are sold for a variety of uses, principal of which are paint products, garment cleaners and motor fuels. From present indications, the output of this plant for 1927 will exceed 100,000 gallons.

The oil gas process as used by the Pacific Gas and Electric Company was developed with the aim of producing the maximum amount of gas from a given quantity of oil without the production of by-products such as are obtained from the manufacture of gas from coal. In our operations, the only by-products produced are the free carbon, or lampblack, as it is locally called, and a small amount of tar contaminated with carbon and naphthalene. The carbon and tar are mixed and recovered together and used for boiler fuel to supply the steam used in operating the gas generators, compressors and other auxiliary equipment. The benzol produced from the dehydration of the high-pressure gas is beginning to be of importance, and as the demands of benzol increase this operation can be enlarged.

Perhaps the most interesting and, at the same time, the most difficult problem undertaken has been the liquid purification of gas for the removal of hydrogen sulphide by means of a wet purification process instead of the iron oxide method. PACIFIC SERVICE MAGAZINE for April, 1926, contained a de-

scription of the purification plants installed at Potrero, Oakland, Sacramento, San Jose and Fresno, and explained how the gas was washed through a solution of soda ash from which a by-product, sulphur, was obtained. The preparation of the sulphur into commercial form was given extensive study during the past year. As this by-product is obtained from the filters it consists of a gray, sticky mud containing about 60 per cent water; the particles of sulphur are so small that they are practically colloidal, and the separation of them from the water without destroying the colloidal structure seems almost impossible. Research by the agricultural laboratory of the University of California developed the discovery that this form of sulphur compound had certain properties due to its colloidal nature, and that other compounds which it contained enhanced its value for sprays, fertilizers and dusting powders. Its activity exceeds that of any other form of sulphur sold for these purposes.

Two lines of research were decided upon: first: Means of producing a commercial product which could be sold to companies manufacturing insecticides and fertilizers; second: To carry on active field tests and prove the findings of the University Laboratory. The first line of procedure involved practically a full year's work of a group of chemists and technical experts and resulted in finding a cheap means for partially dehydrating the paste so that the finished product could be used in the preparation of a lime sulphur solution of exceptionally good quality. By the end of the year over six hundred tons had been delivered for that purpose.

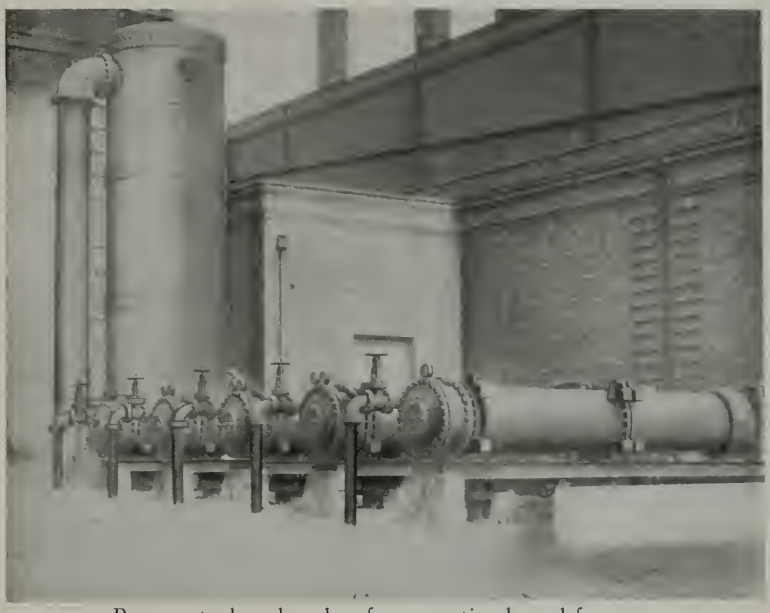
The second line of procedure was entirely a new problem for a gas company. A new product had been produced which had very attractive possibilities for the fruit grower and agriculturist, but no one was ready to accept it until its value could be proven. The work was of such importance that a research entomologist was employed. It is believed that this is the first case on record where a gas company has required the services of an entomologist. At present, through cooperative research between the University of California and the Pacific Gas and Electric Company, the effectiveness of several preparations of sprays and dusting powders made from this by-product sulphur is being determined. It is not being handled from the narrow point of view of simply finding a use for this material, but rather to verify the preliminary indications that by proper preparation and application it may be possible to control certain pests in orchards and gardens more certainly than heretofore, and also, to obtain a fungicide more active at the low temperature of early spring, at which time mildew and rust are sometimes uncontrollable.

The activity of preparations made from this sulphur seems to be due to two prop-



Prune orchard near Yuba City. The tree in the foreground shows the result of sulphur compound treatment for red spider infestation. The trees in the background were not sprayed.

erties: first, the fineness of division of the sulphur particles; second, a certain content of volatile tarry matter which is retained in the sulphur when it is recovered from the solution with which the gas is scrubbed. The size of the sulphur particles is smaller than any type of sublimed or ground sulphur on the market and is finer, even, than any precipitated sulphur with which it has been compared. This extreme fineness is a distinct advantage in agricultural usages, either as a spray or dust in controlling pests, in fertilizing soil and in neutralizing alkali, because the activity in all these uses is largely dependent upon the size of the particle. The smaller the particle the more quickly it will volatilize and hence give better action on mildews and rusts, and the more readily will it enter chemical reaction in soil treatment. These minute particles also adhere to foliage better, the surface coverage is better and there is less tendency to wash off with light rains.



Pressure tank and coolers for separating benzol from gas.

A very extensive program of field tests has been undertaken. In the summer of 1926 both spray and dust were used upon cantaloupe mildew in the Imperial Valley, grape mildew in the San Joaquin Valley and in several localities upon red spider attacking prunes, beans and ornamental plants. Oak trees in Berkeley are now being sprayed for the control of mildew. A similar form of mildew on apples is being treated at Watsonville and at several points further north along the Coast even into Canada. A form of mildew on gooseberries in the Northwest, which has never yielded to sprays, will be experimented with this year as well as mildew on lettuce in California. Only one large experiment on truck crops was possible last year. This was on cantaloupe in the Imperial Valley, where large quantities of this by-product sulphur were dusted over the fields by means of aeroplanes. Trials are being extended to dusting on sorghum in Kansas, and an attempt will be made upon the cotton fleahopper on cotton, a pest recently recognized as serious throughout the cotton belt. In addition, some work will be done upon ornamental plants such as roses, cosmos and zinnias and it is likely that the seasonal development will bring out many other experiments.

It is interesting to note that the sulphur now being produced by the Pacific Gas and Electric Company is the only sulphur now produced in California. The greater part of the supply comes from the Louisiana and Texas fields. In the future, therefore, the local production will become more and more important and the present annual output of about 3000 tons may be readily increased.

Public Relations, Publicity and Creative Sales Campaign

Our company, like all other public utilities in the land, is constantly called upon to deal with the problem of public relations. This not only concerns the personal contact between the company's representatives and the public but it comprehends, in a much wider scope, the creation, through every department and in every phase of the company's activities, of a general atmosphere of mutual confidence and esteem in which the public service and the public it serves move hand in hand along the path of progress and prosperity. This problem of public relations has been a major subject of study among public utility executives for many years and much has been written and much said upon this subject. It is only fair to the public utility at this time to say that there is a marked difference between the public attitude toward the public utility as exhibited, say, a decade ago, and the public attitude of today. The third decisive defeat of the Water and Power Act last fall may be taken as an indication of the general improvement in the attitude of the public toward the public utility.

Nevertheless, in all well-regulated public utilities the public relations campaign is a never-ending one, and each year the campaign takes on a new complexion, so to speak. Taking our company as an instance, good results have been realized during the past year from the prosecution of a public relations and sales program that has combined three leading features deemed essential to the establishment of satisfactory public relations: first, a consistent campaign to develop in our company's sales forces a realization of the opportunity presented to them for the development of public good will through daily personal contact; second, a forceful program of institutional and sales advertising to support the activities of the men in the field by presenting to the public the thought that the company is delivering an essential service of personal comfort and health that is dependable as well as inexpensive; third, a constructive creative sales policy calculated to capitalize these activities and, by the addition of new consumers and the increase in volume of service to existing consumers, materially augment the company's revenues.

During 1926 display advertisements were run regularly in 236 daily and weekly newspapers throughout the company's territory, the combined circulation of which is over 2,500,000. This figure approximates the total population of the territory served. Forty-two institutional ads, eighteen gas sales, twenty-two electric sales and eleven miscellaneous ads were prepared and published. Special advertisements were prepared to tie in with localized events, such as real estate operations, big factory openings, gas appliance campaigns and electric cooking schools. The year's program included approximately 250,000 column inches of display space.

A creative sales campaign prosecuted during the year was largely directed to exploiting new uses for our company's products, to adding new consumers to its lines and to increasing the sale of both gas and electricity to existing consumers through exploiting gas and current consuming appliances. On the electric side, excellent results were obtained from promoting the sale of domestic appliances, and several industries abandoned their isolated electric plants in favor of "Pacific Service." Mare Island Navy Yard is a notable instance.

An active campaign was carried on in the industrial gas field, the major accomplishments in this market during 1926 being the development and sale of industrial appliances of gas in bakeries, and in the textile, metallurgical, glass and chemical industries. Another good market for gas was found in the hotel and restaurant field. In exploiting domestic gas and electric appliances the company pursued the business policy of working in active co-operation with the appliance dealers.

In addition, our sales campaigns were directed to carrying the company's public relations program to its consumers through personal contact.

The Financial Side of "Pacific Service"

Following is a condensed preliminary statement of the Company's earnings for the first quarter of 1927. A comparison with the same period of 1926 is also shown:

	3 Mos. Ended Mar. 31, 1927	Increase
Gross Revenue, including Miscellaneous Income	$14,290,491	$1,299,257
Maintenance, Operating Expenses, Taxes (including Federal Taxes), Rentals, and Reserves for Casualties and Uncollectible Accounts	7,900,648	110,443
Net Income	$ 6,389,843	$1,188,814
Bond Interest and Discount	2,440,286	399,985
Balance	$ 3,949,557	$ 788,829
Renewals and Replacements Reserve	1,226,204	119,372
Surplus	$ 2,723,353	$ 669,457

The gain of $1,299,257 in gross income during the three months ended March 31st, 1927, represents an increase of 10% over the corresponding period of 1926, and is paralleled, from the standpoint of physical operations, by a growth of 8.53% in sales of electricity, and 12.76% in gas sales. Precipitation during the winter months was ample and well distributed. As a result of favorable water conditions, utilization of fuel oil in steam electric generating plants during the first quarter of the current year was practically at a minimum, over 98% of all electricity generated on the Company's system being produced by water power. This condition is to some degree reflected in the relatively small increase of $110,443, or only 1.4%, in operating expenses, notwithstanding the substantially larger volume of business transacted. The balance available for depreciation and return on the Company's investment was $6,389,843, or $1,188,814 in excess of the corresponding figure last year. This increased net income is also, in large measure, a reflection of the additional investment of $16,300,000 in plants and properties during the past twelve months.

The unusual depth of well packed snow in the mountain regions promises a satisfactory run-off for the operation of our hydro-electric plants for some months, deferring beyond the usual period the necessity of drawing on our storage reservoirs, which, in the meantime, are all filled to capacity.

We were serving on March 31st, 880,168 customers, or 54,646 more than a year ago.

First and Refunding Bonds Made Legal Investments for Savings Banks in Massachusetts

The First and Refunding Mortgage Bonds of the Pacific Gas and Electric Company, of which $95,720,000 are outstanding, were on April 12th, 1927, admitted to legality as investments for savings banks in the State of Massachusetts. The Massachusetts banking law under which these bonds have been legalized is among the most conservative in the country with respect to the character of securities which may be utilized for the investment of savings bank funds.

All of the Company's outstanding First and Refunding issues, namely, the Series "A" 7%, Series "B" 6%, Series "C" 5½%, and Series "D" 5% were found by the Massachusetts Banking Commission to qualify in that State. These bonds were already legal investments for savings banks in California, Maine, New Hampshire, Vermont, and other States.

CONSOLIDATED BALANCE SHEET

ASSETS

PLANTS AND PROPERTIES			$294,183,114.16
DISCOUNT AND EXPENSES ON CAPITAL STOCKS			9,197,396.39
INVESTMENTS			140,941.75
TRUSTEES OF SINKING FUNDS (excluding Company Bonds in Sinking Funds):			
Cash		$227,078.04	
Accrued interest on bonds held in Sinking Funds		197,228.21	
Total Trustees of Sinking Funds			424,306.25
CASH IN HANDS OF TRUSTEES—For redemption of notes and bonds			18,071.50
ADVANCES FOR CONSTRUCTION—Leased properties			4,320,061.02
CURRENT ASSETS:			
Cash		$13,809,078.29	
Notes receivable	$ 641,652.42		
Accounts receivable	4,269,462.94		
Total	$4,911,115.36		
Less reserve for doubtful accounts and notes	104,080.09	4,807,035.27	
Installments receivable from subscribers to first preferred and common capital stocks		3,300,190.05	
Materials and supplies		5,082,945.04	
Accrued interest on investments		5,470.26	
Total Current Assets			27,004,718.91
DEFERRED CHARGES:			
Unamortized bond discount and expense, etc.			7,861,849.30
Total			$343,150,459.28

MARCH 31, 1927

LIABILITIES

CAPITAL STOCKS OF PACIFIC GAS AND ELECTRIC COMPANY, including Stocks subscribed for, but not fully paid:		
First Preferred Capital Stock	$69,965,456.91	
Common Capital Stock	$75,128,873.33	
Less—Owned by Subsidiary Company	15,848,433.33	
	59,280,440.00	
Total Capital Stocks of Pacific Gas and Electric Company		$129,245,896.91
CAPITAL STOCKS OF SUBSIDIARY COMPANIES not held by the Pacific Gas and Electric Company and Unpaid Dividends thereon		1,197.46
FUNDED DEBT:		
Pacific Gas and Electric Company Bonds	$131,515,000.00	
Bonds of Subsidiary Companies	37,702,800.00	
Total Funded Debt		169,217,800.00
CURRENT LIABILITIES:		
Accounts Payable	$ 1,507,204.00	
Drafts Outstanding	374,848.33	
Meter and Line Deposits	812,439.51	
Dividends	1,089,171.68	
Bond Interest Due	129,264.50	
Accrued Interest—not due	3,106,021.08	
Accrued Taxes—not due	1,872,584.11	
Service Billed in Advance	295.58	
Total Current Liabilities		8,891,828.79
RESERVES:		
For Northern California Power Company Consolidated Plant Adjustments and Accrued Depreciation	$ 1,647,970.05	
Depreciation	19,486,685.03	
Insurance, Casualty and other	593,011.70	
Reserve for amounts charged during 1913, 1914, 1915, 1916 and 1917 to consumers in excess of rates allowed by city ordinances	1,813,760.27	
Reserve for Maintenance of Capital	144,144.80	
Total Reserves		23,685,571.85
SURPLUS		12,108,164.27
Total		$343,150,459.28

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE
PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVI APRIL, 1927 NO. 12

The "Pacific Service" record for 1926, the twenty-first year of our company's corporate existence, contains considerable material that is of interest to the cause of progress and development in every section of the territory covered by its operations.

To begin with, the fifty million dollar mark has been passed. Our company's gross operating revenues for last year amounted to $50,960,571, an increase of $3,231,492 over the preceding year. Comparison of the returns by years since 1906 opens to view an unbroken record of growth from the first. There have been fat and lean years in this period, times of inflation and times of depression, but through them all the story of "Pacific Service" has been one of steady upbuilding, with no looking back. It has been stated many times and oft that a public utility must keep in the van of progress, must be prepared not only to meet the exigencies of the occasion, but, also, to anticipate the future. Through this record, then, may be traced, to considerable extent, the story of north-central California, with its constant increase of population and resultant increase in demand for the essential commodities which a company like ours is in business to supply. With growth of population has come growth of industry of all kinds, and in the stimulation of industry "Pacific Service" has played and will continue to play a leading part.

To the record total of operating revenues for 1926 the Electric Department contributed $31,390,566, or 61.60 per cent of the whole, with the substantial increase of $3,089,235 over the previous year. The Gas Department was responsible for a total of $17,518,527, or 34.37 per cent of the total revenues. At the present time the number of consumers receiving electric service for our company stands at 434,887, an increase of 29,108 over 1925, and the number of gas consumers 418,541, an increase of 30,834 over the previous year. It is worthy of mention that in the past ten years our company has made a net gain of 256,257 electric consumers — considerably more than double—and a net gain of 185,793 gas consumers. In connection with this record on the electric side it may be stated that the year 1926 gave our company a gain of 36.36 per cent in kilowatt hour sales for cooking and heating, the result of an active electric appliance campaign which was prosecuted throughout the year. Total sales of electric energy during the year amounted to 1,514,980,516 kilowatt hours. Gas sales during the year amounted to 17,482,206,900 cubic feet.

At the close of 1926 our company had 28 hydro-electric plants in operation with a total installed capacity of 536,829 horsepower, of which 235,926 horsepower, or 44 per cent of the total, was represented by the plants constructed in the Pit River region during the past years. The company's resources in the way of steam-electric generation included four plants, with a total installed capacity of 190,349 horsepower. In all, then, the company's aggregate electric-generating resources at the close of 1926 were of 728,178 horsepower installed capacity. The total load connected to the company's system aggregated 1,640,770 horsepower, an increase of 9.5 per cent over the previous year. Electric service was furnished to 296 cities and towns in California and to a large productive rural area, 59,000 square miles in extent, with a total population estimated at approximately two and one-half millions. On the gas side, our company's manufacturing resources embraced 17 plants, with a total generating capacity of 112,100,000 cubic feet per day of twenty hours. Of the total sales amounting to 17,482,206,900 cubic feet, San Francisco, operating two plants and extending service to twenty-one cities and suburban districts, was responsible for 8,220,993,400 cubic feet, or nearly one-half, while Oakland, serving ten cities and suburban districts, came second with 5,622,562,500 cubic feet, and Sacramento third with 1,105,925,400 cubic feet.

In view of the substantial additions to our company's electric-generating resources which became available in the latter part of 1925, there was deemed no occasion for any noteworthy increase in the productive capacity of the Electric Department, so the activities of our engineering forces during 1926 were devoted primarily to perfecting and consolidating the company's substation and distribution systems. Reconstruction work was carried on at 33 substations, 10 substations were abandoned in their entirety and 6 high-tension and 6 low-tension substations were constructed and connected to the company's lines. The net total of, in round numbers, 140,500 horsepower of additional transformer capacity was connected for service at substations and power houses. A number of small distribution systems heretofore supplied with energy at wholesale by our company, were purchased. Among these were the properties of the Middle Yuba Electric Power Company, operating in the mining district of Sierra and Nevada Counties, Peters Brothers and Towle Brothers Companies, operating small electric distribution systems at Dutch Flat and Towle, respectively, the Bell Electric Company, distributing electricity in the city of Auburn, and the Lake County Water and Power Company, operating a small electrical transmission and distributing system in Lake County.

In a previous issue of PACIFIC SERVICE MAGAZINE our readers were informed of two major projects in which our company is co-operating with irrigation districts in the development of sections of the "Pacific Service" territory where agricultural expansion is in process. The projects referred to are, first, the Nevada County Irrigation project, in the development of which our Spaulding-Drum system is called into play, and the South San Joaquin and Oakdale Irrigation project, involving large sections of the counties of Stanislaus and San Joaquin. In each case our company is enabling the successful completion of the irrigation project by the purchase of water for power construction purposes, the power to be generated thereby to be placed at the disposal of consumers in the sections covered by these operations. Both projects are now in full process. The Melones power plant, on the Stanislaus River below the Melones dam recently opened for service by the Oakdale and South San Joaquin Irrigation Districts, is expected to reach completion early in June, while the Nevada project, which, so far as our company is concerned, involves extensions of equipment at Drum and the two Spaulding plants and the construction of a new power plant on the rim of Lake Spaulding, is in such shape that "Pacific Service" will be in a position to be of considerable aid to the farmers of Placer County by the time the irrigation season opens this year, though the entire project may not reach completion before the summer of 1928.

In the gas department there has been a continuation of the program of increasing the efficiency and capacity of generating facilities which has been in progress since 1920. As a matter of fact, all of the company's large gas-generating plants have been rebuilt during the past seven years, a work that has resulted in approximately doubling the capital invested in gas properties as of December 31, 1919. Gas sales as measured in cubic feet have nearly doubled in that time. Notable features of this department's record for 1926 include the installation of a 10,000,000 cubic feet waterless gas holder at East Oakland and the revival of coal gas manufacture at Marysville. This latter, as stated elsewhere in this issue, is in the nature of an experiment and has been undertaken with a view of affording a practical basis for comparison of the relative merits of coal and oil with respect to both cost of production and the quality of the product.

During the past year our company purchased the properties of the Sacramento Gas Company, furnishing service to consumers in Sacramento and Lodi. The purchase by our company of the municipal gas distributing system of the town of Santa Clara is also noted.

Some of the most interesting features of the work accomplished by the electric and gas departments during the year are described in special articles in this issue.

In the twenty-one years since its organization our company has increased its plant account by $218,521,266 through construction and the acquisition of additional properties. Of this amount $151,985,103.75 represents the total for the past eight years. In the seven years from 1920 to 1926, $132,446,000 has been expended on new construction.

It is worthy of note that the company's 1926 tax bill (State and Federal) amounted to $4,567,050, a sum equal to the gross revenue of the entire property for thirty-three days, and equivalent to 60 per cent of all the dividends paid during 1926 on the average amount of $109,647,600 of capital stock of both classes outstanding during the year.

As of December 31, 1926, there were 39,149 stockholders, an increase of 4,286 within the year. California stockholders number 32,514, or 83 per cent of the total.

The membership of the Pacific Service Employees' Association at the close of the year numbered 8,159. Through the employees' disability plan, which has an enrolled membership of 4,450, there was paid in benefits during 1926 the sum of $38,816.

The average number of employees on the company's pay roll last year was 10,847. There are now 3,321 employees wearing service badges given in recognition of continuous employment for five years or longer.

The annual meeting of the company's stockholders was held at headquarters in San Francisco on April 12th last. President Wigginton E. Creed was in the chair and complete reports of progress were presented by First Vice-President and General Manager Frank A. Leach, Jr., and Second Vice-President and Treasurer A. F. Hockenbeamer. At the conclusion of the meeting the existing board of directors was re-elected.

The people of northern California appear to be getting chary of voting money for so-called public ownership purposes. In less than six months four cities in this section of the State have voted against municipal ownership of public utilities.

A bond issue of $150,000 to purchase or construct an electrical distribution system for Oroville was put up to the people of that city on March 24th. It required a two-thirds vote to carry. The returns showed 397 votes for the bonds and 649 against.

The voters of the time-honored city of Marysville a month ago were called upon to sanction a bond issue for the purpose of purchasing the local water system. The poll gave 434 votes for the bonds and 927 against, so that more than two-thirds of the voters declared in the negative.

The city of Roseville early in the year voted on a similar plan. The vote there was: Yes, 175; no, 528.

In December last the city of Santa Clara formally declared itself out of the gas business. For many years the local gas plant was municipally owned and operated, but two years ago the plant was shut down and although the municipality continued to sell and distribute gas to the people, it purchased the commodity wholesale from our company's generating plant at the adjacent city of San Jose. At this December election referred to the people decided to sell its distributing system, the vote being 529 in favor to 39 against the proposition. In accordance with this decision, our company paid the municipality $50,000 for the local distributing system and is expending a further sum of $80,000 upon additions and betterments of service.

READERS OF PACIFIC SERVICE MAGAZINE,
TAKE NOTICE!

This number is the last of Volume 16, and, as has been done in the past, each district office will be supplied with a bound copy for the office library.

Those who have all the copies of Volume 16, or any previous volume, in perfect condition, may have them bound by forwarding them, charges prepaid, to the Stationery Department. The charges for binding will be $1.50 per volume, and remittance must accompany magazines.

FORWARD MAGAZINES AND MAKE REMITTANCE TO

STATIONERY DEPARTMENT—*Pacific Gas and Electric Company*
245 MARKET STREET, SAN FRANCISCO

Name of sender with full and complete address must be plainly marked on each package
No magazines or remittance will be accepted after June 30

PACIFIC GAS & ELECTRIC COMPANY

A California Corporation

Managed by Californians Operated by Californians

"Pacific Service" Represents (as of December 31, 1926)

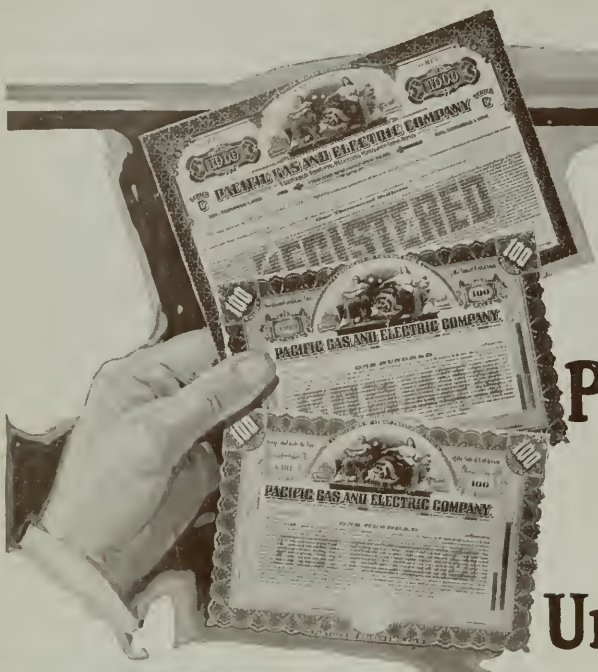
10,800	employed in all departments.
$291,000,000	capital invested in gas, electricity, railroads, steam, water and telephone plants.
59,000	square miles of territory in which it operates—an area greater than that of England and Wales.
39,149	stockholders.
38	counties of the state in which it transacts business.
874,724	consumers served with gas, electricity, water and steam.
2,472,000	people in 38 counties, which is over 50 per cent of the State population.
297	cities and towns in which it supplies service directly and through other companies.
$19,064,280	annual wages paid employees, year ending December 31, 1926.
$4,470,387	taxes, Federal, state, county and local, year ending December 31, 1926.
536,829	horsepower developed in 28 electric water-power plants.
190,349	horsepower developed in 4 electric steam plants.
727,178	total horsepower developed in 32 plants.
1,514,981,000	kw. hrs. sold, year ending December 31, 1926. This is equivalent to the effort of 5,039,936 men.
17,482,206,900	cubic feet of gas sold, year ending December 31, 1926.
17	gas plants.
13,778	miles of transmission and distribution lines. Greater than the distance between San Francisco and Mozambique, East Africa.
4,468	miles of mains used in distributing gas. Greater than the distance between San Francisco and Lima, Peru.
1,140	miles of mains and ditches used in distributing water.
1,100	miles of track of street railway supplied with electric power.
33,192,948,000	gallons of water storage capacity of 112 lakes and reservoirs. This amount of water would supply the City of San Francisco at the present rate of consumption for approximately 5 years.
115,373	acres of land owned in California.
293	parcels of property owned in cities and towns.
4,637,274	barrels of California Oil used, year ending December 31, 1926.
206,302	horsepower in agricultural motors depending on "Pacific Service."
629,331	horsepower in mining, electric railways, manufacturing and other motors depending on "Pacific Service."
40,793	street lamps, gas and electric, lighted by "Pacific Service."
8,230,014	incandescent lamps nightly lighted.
1,641,878	horsepower connected to system.

Pacific Gas and Electric Company

General Office: 245 Market Street

San Francisco

Branches in all principal cities and towns of 38 counties of North Central California.



Three of the Premier Public Utility Securities of the United States

Pacific Gas & Electric Company

First and Refunding Mortgage Bonds
First Preferred Stock (6%)
Common Stock (8%)

Every One of the
EIGHTY THOUSAND
INVESTORS
owning bonds
or stocks of the
PACIFIC GAS AND
ELECTRIC CO.
receives
A REGULAR
INCOME
from his investment

are held in high regard by the investing public because

They are securities of one of the largest, strongest and most progressive of the nation's public service companies;

The property securing these issues is worth millions of dollars more than the entire outstanding capitalization;

The Company's business is essential in character, and is increasing steadily year by year;

These securities are always readily marketable. They are listed on Stock Exchanges in San Francisco and other financial centers.

PACIFIC GAS AND ELECTRIC COMPANY
Stock Sales Department
245 MARKET STREET SAN FRANCISCO, CAL.